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# CALANOID COPEPODS FROM EQUATORIAL WATERS OF THE PACIFIC OCEAN

By GEORGE D. GRICE

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## ABSTRACT

A systematic study was made of the calanoid copepods found in 14 zooplankton samples, four of which were obtained from within the recently discovered equatorial undercurrent (Cromwell current), collected between 5° N. and 5° S. and 130° E. and 120° W.

One hundred and ten species belonging to 18 families were recorded. Descriptive notes, measurements and figures were given for most species with citations to previous occurrences in the Pacific Ocean.

Except for *Scolecithricella tenuiserrata* (Giesbrecht), the copepod species in samples collected from within the equatorial undercurrent were not very different from those in samples obtained adjacent to the current. The numerical abundance and species diversity in equatorial waters were briefly compared with that reported for the northwestern Pacific Ocean. *Acrocalanus andersoni* Bowman, *Chirundina indica* Sewell and *Haloptilus fertilis* (Giesbrecht) were reported for the first time from the Pacific Ocean.

Three species, *Xanthocalanus dilatus, Amallophora smithae* and *Scolecithricella tropica,* are described as new, and hitherto unknown males of *Gaetanus miles* Giesbrecht and *G. minor* Farran are briefly illustrated from juvenile specimens. It was proposed that *Euchirella brevis* Sars is a synonym for *E. amoena* Giesbrecht; *Euchaeta consimilis* Farran for *E. concinna* Dana; *Scoecithrix longicornis* Scott, and *Scolecithricella spinipedata* Mori for *Scolecithricella ctenopus* (Giesbrecht); and *Centropages pacificus* Chiba for *C. elongatus* Giesbrecht.

# CALANOID COPEPODS FROM EQUATORIAL WATERS OF THE PACIFIC OCEAN

By GEORGE D. GRICE, *Woods Hole Oceanographic Institution* [1]

The present paper concerns the calanoid copepods found in plankton samples collected along the equator, an area which has been relatively unexplored taxonomically.

Systematic studies on calanoid copepods have made these microcrustaceans one of the better known groups of the holoplankton of the Pacific Ocean. Extensive taxonomic reports are available for the north Pacific (Brodsky, 1950), the northeast Pacific (Davis, 1949), the western Pacific (Vervoort, 1946; Tanaka, 1953), and the Pacific sector of the Antarctic (Vervoort, 1957). In addition there are numerous smaller but nevertheless valuable papers concerning the calanoid copepods of more restricted areas. Although there remain large, unexplored areas, these recent papers and certain of the older ones (e.g., Scott, 1909) provide a framework for a zoogeographic study of Pacific calanoids and, moreover, show where additional investigations are needed.

Most of the laboratory work of this study was done in Honolulu, Hawaii, in 1958 and 1959 under a fellowship from the John Simon Guggenheim Memorial Foundation. I wish to express my appreciation to the Foundation for the opportunity to make this study. The U.S. Fish and Wildlife Biological Laboratory furnished space for the work, the use of their library facilities and a part of their extensive plankton collections. It is a pleasure to acknowledge the cooperation of Thomas S. Aus-

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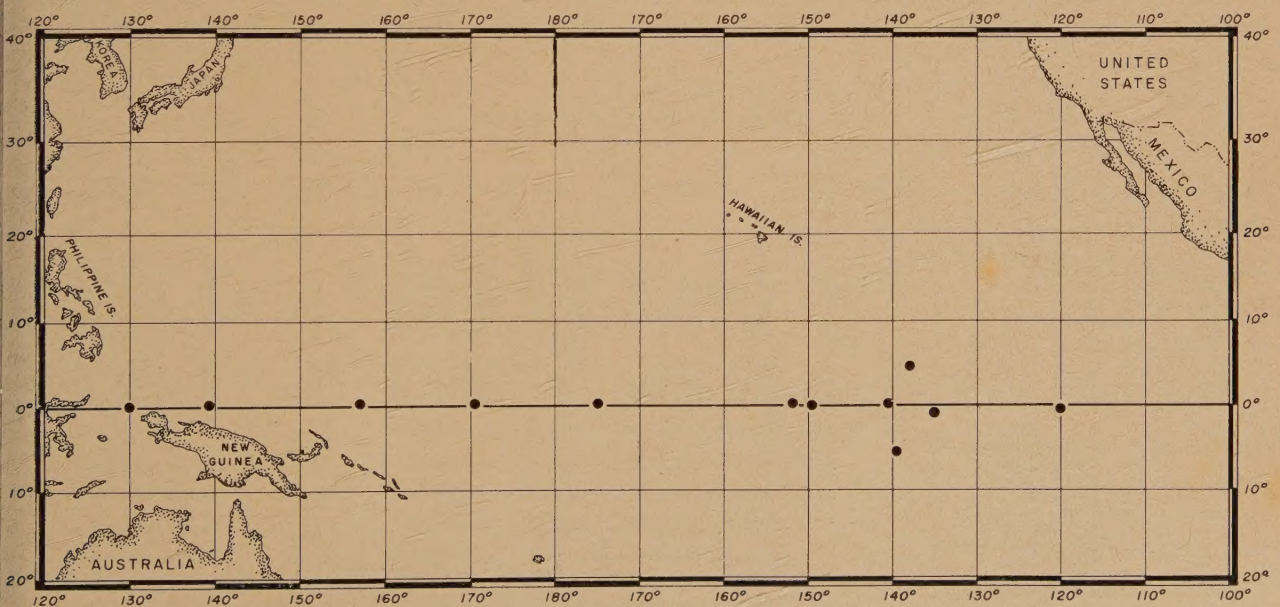


FIGURE 1. Positions where plankton samples were obtained.

tin and E. C. Jones. I wish also to thank Dr. Paul Illg for his advice during the course of the work, Dr. Thomas E. Bowman for reviewing the manuscript, and my wife, Joan, for assistance in completing the drawings.

## MATERIALS

The present report is based on the examination of 14 plankton samples collected between 5° N. and 5° S. latitude and between 130° E. and 120° W. longitude in the Pacific Ocean (fig. 1). The pertinent data associated with each plankton collection are presented in table 1. Hydrographic data associated with these collections are given by King, Austin, and Doty (1957) for the research vessel *Hugh M. Smith*, cruise 31, and by Austin (1957) for cruise 35. Processed reports containing hydrographic data have been issued for *Orsom* cruise 56–4 (Legand, 1957), for *Stranger* and *Horizon* cruises (Scripps Institution of Oceanography, 1957), and for *Satsuma* and *Kagoshima* cruises (Japanese Hydrographic Office, 1956).

Four of the 14 samples (*Smith* cruise 31, stations 94, 144, 178, and cruise 47, station 31) were obtained from the recently discovered equatorial undercurrent (Knauss and King, 1958) by means of closing net gear. In addition, one oblique tow (*Smith* cruise 35, station 63) apparently passed within the undercurren at least during part of the tow.

The three samples obtained on cruise 47 wer oriented with respect to the undercurrent. On sample (cruise 47, station 31) was collecte within the current, and the other two were ob tained from below it (cruise 47, station 29) and from above it (cruise 47, station 30).

Six collections (*Smith* cruise 35, station 63 *Stranger* 34, *Orsom* 10, *Horizon* 32, *Satsum* 32, and *Kagoshima* 613) were selected from large number of plankton samples obtained b vessels participating in a large scale quasi-syn optic study (Operation Equapac) in Pacifi equatorial waters. The samples used in th present studies are those obtained nearest t the Equator by each of the vessels.

## METHODS

Owing to the large volume of most of th samples, except *Kagoshima* 613, it was no practical to examine the entire contents of each In order to estimate the percentage represen tation and the numerical abundance of th common species, small quantities of the orig inal samples were examined. These sub-sam ples, the sizes of which are given in table 2 were obtained by means of a plankton splitte (McEwen, Johnson, and Folsom, 1954). O

TABLE 1.—*Plankton station data*

| Research vessel | Agency | Cruise No. | Station No. | Position | Date | Time[1] | Size of net | Mesh (mm.) | Depth [2] (m.) | Wate filtere (m.[3]) |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | *1955* | | | | | |
| *Hugh M. Smith* | U.S. Fish and Wildlife Service. | 31 | 94–2 | 00°11′S 119°58′W | Nov. 7 | 0916–0946 ZT | 1 m. | 0.65 | 146–72 CN | 590. |
| Do | do | 31 | 132–2 | 04°40′N 138°14′W | Nov. 17 | 0921–0950 ZT | 1 m. | .65 | 119–63 CN | 690. |
| Do | do | 31 | 144–2 | 00°16′N 140°12′W | Nov. 20 | 1000–1036 ZT | 1 m. | .65 | 122–61 CN | 38. |
| Do | do | 31 | 153–3 | 05°31′S 139°54′W | Nov. 22 | 1008–1039 ZT | 1 m. | .65 | 126–63 CN | 966. |
| Do | do | 31 | 178–2 | 00°21′N 151°40′W | Dec. 6 | 0917–0947 ZT | 1 m. | .65 | 146–68 CN | 283. |
| | | | | | *1958* | | | | | |
| Do | do | 47 | 30 | 00°00′ 149°36′W | Oct. 27 | 1118–1151 ZT | 1 m. | .65 | surface | 1342. |
| Do | do | 47 | 31 | 00°00′ 149°33′W | do | 1153–1246 ZT | 1 m. | .65 | 100 CN | 380. |
| Do | do | 47 | 29 | 00°00′ 149°38′W | do | 0953–1112 ZT | 1 m. | .65 | 500 CN | 922. |
| | | | | | *1956* | | | | | |
| Do | do | 35 | 63–1 | 01°10′S 134°57′W | Aug. 19 | 2116–2152 ZT | 1 m. | .66 | 169 Q | |
| *Stranger* | Scripps Institution of Oceanography. | | 34 | 00°01′N 174°59′W | Sept. 15 | 0352 GMT | 1 m. | .56 | 0–140 Q | |
| *Orsom* | Institut Français d'Océanie. | 56–4 | 10 | 00°35′N 170°11′E | Oct. 4 | 2338–2457 LT | 50 cm. | .366 | 150 Q( ) | 616. |
| *Horizon* | Scripps Institution of Oceanography | | 32 | 00°03′S 157°00′E | Aug. 25 | 0428 GMT | 1 m. | .56 | 0–280 Q | |
| *Satsuma* | Japan Hydrographic Office. | | 32 | 00°29′N 139°49′E | Aug. 18 | 2100–2210 ZT | 45 cm. | .33 | 0–150 Q | 20. |
| *Kagoshima–Maru* | Kagoshima University, Japan. | | 613 | 00°38′N 130°20′E | Aug. 1 | 0725–0955 ZT | 22.5 cm. | .11 | 0–50 V | |

[1] ZT, zone time; LT, local time; GMT, Greenwich mean time.
[2] CN, closing net; Q, oblique open net; V, vertical open net.

TABLE 2.—*List of species and number of specimens in each sub-sample*

["X" indicates the species was found during the examination of other fractions of original sample]

| Species | *Hugh M. Smith* | | | | | | | | | *Stranger* | *Orsom* | *Horizon* | *Satsuma* | *Kagoshima* |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 94 | 132 | 144 | 153 | 178 | 30 | 31 | 29 | 63 | 34 | 10 | 32 | 32 | 613 |
| 1. Calanus tenuicornis | 2 | 1 | | 3 | 2 | | | | | | | 1 | | |
| 2. Nannocalanus minor | 1 | 44 | 2 | 21 | 41 | | 2 | X | 2 | 6 | 6 | 12 | | |
| 3. Canthocalanus pauper | | | | | | | | | 1 | 1 | | 2 | | |
| 4. Neocalanus gracilis | X | 8 | | 6 | | | 17 | | | X | X | | X | |
| 5. N. robustior | | | | 1 | X | | | | 1 | X | | | | |
| 6. Undinula vulgaris | | | | | | | | | | | | | X | |
| 7. U. darwini | 1 | 1 | 4 | 72 | 57 | 20 | 11 | X | 39 | 6 | 2 | 11 | 6 | |
| 8. Eucalanus attenuatus | | 1 | | 15 | 4 | 1 | 15 | | 15 | X | | 11 | | |
| 9. E. mucronatus | | | | | | | | | | | | 2 | | |
| 10. E. subtenuis | 1 | 85 | 86 | 2 | 173 | | 39 | | 45 | | | | | |
| 11. E. pileatus | | | | | | | | | | | | | 1 | |
| 12. E. subcrassus | | | | | | | | | 3 | X | 4 | | | |
| 13. Rhincalanus cornutus | X | | 1 | 1 | | | 3 | 48 | 9 | 1 | 2 | 1 | 5 | |
| 14. R. nasutus | 1 | | | | | | | | | | | | | |
| 15. Paracalanus aculeatus | | | X | 3 | 3 | | 1 | | 11 | 3 | 4 | 1 | | |
| 16. P. parvus | X | | | | | | | | | | | | | |
| 17. P. dubia | | | | | | | | | | | | | | 1 |
| 18. Acrocalanus longicornis | | | | 2 | | | 1 | | 1 | X | | | | |
| 19. A. andersoni | | | | | | | | | | 1 | X | | | 1 |
| 20. A. monachus | | | | | | | | | | X | X | 3 | | |
| 21. Calocalanus pavo | | | | 1 | | | | | 1 | 1 | 1 | X | | |
| 22. C. plumulosus | | | | | | | | | | | | | X | |
| 23. Clausocalanus arcuicornis | 3 | 75 | 4 | 9 | 27 | 15 | 11 | | 3 | 12 | 18 | 9 | 5 | |
| 24. C. furcatus | | 30 | | 14 | 3 | | 1 | | 6 | 6 | | 4 | 1 | |
| 25. Euaetideus giesbrechti | 1 | | 1 | | | | | X | X | | | | | |
| 26. E. acutus | 5 | 2 | 3 | X | 11 | X | 4 | | X | X | | | | |
| 27. E. bradyi | 13 | | 3 | | | | | | X | | | | | |
| 28. Chiridius poppei | 2 | | | | | | | | X | | | | | |
| 29. Gaetanus miles | | | | | | | | | X | | | | | |
| 30. G. minor | | | | | | | | 2 | X | | | | | |
| 31. Euchirella bella | | | | X | | | X | 6 | 3 | | | X | | |
| 32. E. venusta | | | | | | | | | X | X | | | | |
| 33. E. pulchra | | | | | | | | | X | | | | | |
| 34. E. amoena | | X | X | X | X | | | | X | | | | | |
| 35. E. curticauda | | | | | | | | | | | X | | | |
| 36. E. maxima | | | | | | | | X | | | | | | |
| 37. Pseudochirella sp. | | | | | | | | X | | | | | | |
| 38. Chirundina streetsi | | | | | | | | | | | | X | | |
| 39. C. indica | | | | | | | | | X | | | | | |
| 40. Undeuchaeta plumosa | | | | | | | | | X | | | X | 1 | |
| 41. U. intermedia | | | | | | | | | 1 | | | X | | |
| 42. Euchaeta marina | | 1 | X | 33 | 8 | 34 | 12 | | 7 | 5 | X | 2 | | |
| 43. E. wolfendeni | | 1 | | | | | | | 1 | 5 | | 4 | 2 | |
| 44. E. media | | | | | | | | | 1 | | | | | |
| 45. E. tenuis | | | | | | | | 1 | 1 | | | X | | |
| 46. E. concinna | | | | | | | | | | | | | 4 | |
| 47. E. longicornis | 2 | 4 | | | | | | | | | | | | |
| 48. E. spinosa | | | | | | | | X | | | | | | |
| 49. Phaenna spinifera | 3 | X | | | | | X | | 1 | | X | X | | |
| 50. Xanthocalanus dilatus n. sp. | | | X | | | | | | | | | | | |
| 51. Amallophora smithae n. sp. | | | X | | | | | | | | | | | |
| 52. Scolecithrix danae | | 2 | 4 | 18 | 5 | X | 26 | X | 17 | 3 | 1 | 7 | 6 | |
| 53. S. bradyi | 14 | 4 | X | | 1 | | 1 | | | | | | | |
| 54. Scolecithricella ctenopus | 1 | | | | 1 | | | | | 1 | X | | | |
| 55. S. abyssalis | 8 | | X | | | | | 1 | 1 | | | | | |
| 56. S. vittata | 4 | | | | | | | | | | | | | |
| 57. S. tenuiserrata | | | 6 | | 9 | | 2 | | 1 | 2 | | | | |
| 58. S. marginata | | | X | | X | | | | | | | | | |
| 59. S. tropica n. sp. | 4 | 4 | | | 2 | | | | | | | | | |
| 60. S. sp. | | | X | | | | | | | | | | | |
| 61. Scaphocalanus echinatus | | | | | | | | | X | | | | | |
| 62. S. longifurca | 1 | | | | | | | X | 1 | | | | | |
| 63. Scottocalanus securifrons | | | | | | | | | | | | X | | |
| 64. S. farrani | | | | | | | | X | | | | | | |
| 65. S. sedatus | | | | | | | | X | | | X | | | |
| 66. Temoropia mayumbaensis | X | | | | | | | | | | X | | | |
| 67. Metridia venusta | | | 7 | | | | | | | | | | | |
| 68. Pleuromamma xiphias | | | | | | | | | X | | X | | 1 | |
| 69. P. abdominalis | 2 | | | | | | | 13 | 7 | | X | 1 | 5 | |
| 70. P. indica | | | | | | | | | | | | | 1 | |
| 71. P. quadrungulata | | | | | | | | 5 | X | | | | | |
| 72. P. gracilis | 1 | | | | | | | 12 | X | | | 1 | X | |
| 73. P. borealis | | | | | | | | | X | | X | | 1 | |
| 74. Centropages gracilis | | 1 | | X | X | 7 | | | | X | | | X | |
| 75. C. elongatus | | | | X | | | | | | | | X | X | |
| 76. C. calaninus | | | | | | X | | | | | | 1 | | |
| 77. Lucicutia flavicornis | 15 | 3 | X | | 11 | | 3 | X | | 1 | | | 1 | |
| 78. L. ovalis | | X | | 1 | 4 | | | | X | 2 | 1 | 1 | | |
| 79. Heterorhabdus spinifrons | | | 2 | | | | | 3 | 1 | | | | X | |
| 80. H. papilliger | 5 | 6 | 10 | | 27 | | 9 | 1 | 1 | X | X | | | |
| 81. Haloptilus longicornis | 19 | 12 | 43 | X | 26 | | 50 | | 1 | X | 1 | X | 13 | |
| 82. H. acutifrons | X | | | | | | | | | | | | | |
| 83. H. fertilis | | | | | | | | | | | | X | | |
| 84. H. ornatus | | | | | | | | | X | | | | | |
| 85. H. spiniceps | X | | | | | | | | | X | X | X | X | |
| 86. H. austini | 1 | | | | | | | | | | | | | |
| 87. Augaptilus longicaudatus | X | | | | | | | | | | | | | |
| 88. Euaugaptilus hecticus | | | | | | | 2 | | | X | | | X | |

TABLE 2.—*List of species and number of specimens in each sub-sample*—Continued

["X" indicates the species was found during the examination of other fractions of original sample]

| Species | *Hugh M. Smith* | | | | | | | | | *Stranger* | *Orsom* | *Horizon* | *Satsuma* | *Kagoshim* |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 94 | 132 | 144 | 153 | 178 | 30 | 31 | 29 | 63 | 34 | 10 | 32 | 32 | 613 |
| 89. Arietellus setosus | | | | | | | | | X | | | | | |
| 90. A. giesbrechti | | | | | | | | X | | | | | | |
| 91. A. plumifer | 1 | | | | | | | | X | | | | | |
| 92. A. aculeatus | | | | | | | | | X | | | | | |
| 93. Candacia longimana | | | | | | | | | | | | X | X | |
| 94. C. guggenheimi | | | | | | | | X | | | | | | |
| 95. C. tenuimana | | | | | | | | X | | | | | | |
| 96. C. aethiopica | | | | | | X | | | | | | X | X | |
| 97. C. pachydactyla | | X | | X | X | X | | | 1 | X | X | X | | |
| 98. C. curta | | | | | | | | X | | | X | X | | |
| 99. C. bipinnata | | | X | | X | | | | | | | | | |
| 100. C. varicans | | | | | | | 1 | | X | | | | | |
| 101. C. catula | | | | | X | | | | 1 | X | X | X | | |
| 102. C. bispinosa | | | | 3 | X | | | | | X | X | | 1 | |
| 103. C. simplex | X | 5 | X | X | 1 | | | | | | | | | |
| 104. C. truncata | | X | | 1 | | X | | | X | 1 | X | 8 | 15 | |
| 105. Pontella securifer | | | | | | X | X | | | | | | | |
| 106. P. tenuiremis | | | | | | | | | | | | X | | |
| 107. Labidocera detruncata | | | | | | X | | | | | | X | | |
| 108. Pontellina plumata | | X | | | X | 7 | X | | X | 1 | X | 1 | | |
| 109. Acartia danae | 1 | 1 | | | X | | | | | | | | | |
| 110. A. negligens | | | | 2 | 2 | 70 | 5 | | X | X | 27 | | X | |
| Unidentified copepodids | 22 | 70 | 18 | 5 | 22 | 0 | 0 | 41 | 44 | 30 | 2 | 23 | 28 | |
| Number of specimens in sub-sample | 134 | 361 | 194 | 213 | 440 | 154 | 216 | 133 | 228 | 88 | 67 | 106 | 97 | |
| Sub-sample size | 1/16 | 1/64 | 1/8 | 1/256 | 1/16 | 1/32 | 1/4 | 1/64 | 1/512 | 1/256 | 1/256 | 1/256 | 1/2 | a |
| Number of copepods per cubic meter | 3.6 | 33.4 | 40.8 | 56.4 | 24.8 | 3.7 | 2.3 | 9.2 | | | 27.8 | | 9.3 | |
| Number of species | 34 | 27 | 26 | 27 | 31 | 15 | 25 | 25 | 55 | 35 | 31 | 39 | 29 | |

completing the analysis of the sub-sample, portions of the original sample were examined for species not found in the aliquot. The species in each sample are listed in table 2 along with the number of specimens of each found in the aliquot.

Representatives of most species from each station were segregated by sex and placed in labeled vials. This material will be deposited in the U.S. National Museum.

## GENERAL REMARKS

### Species composition

A total of 110 species of calanoid copepods was found in the samples (table 2). Of these, three species belonging to the genera *Xanthocalanus, Amallophora,* and *Scolecithricella* are described as new, and three species, *Acrocalanus andersoni, Chirundina indica,* and *Haloptilus fertilis,* are reported for the first time from the Pacific Ocean.

The collections examined were obtained from along the Equator from 120° W. to 130° E., a distance of approximately 5,800 miles (fig. 1). Many of the species were widely distributed and occurred in samples collected in the eastern Pacific (east of 170° W.) and those collected in the western Pacific (west of 170° W.). Dis regarding the small collection made at *Kago shima* station 613, the most frequently occur ring species were *Nannocalanus minor, Un dinula darwini, Clausocalanus arcuicornis,* an *Scolecithrix danae.* These four species wer present in all but one or two samples.

A study of table 2 will reveal that ther were at least 6 species which were frequentl found (4 or more samples) in the eastern Pa cific, but which were not found in the sample examined from the western Pacific. One o these, *Eucalanus subtenuis,* was the most abun dant copepod in three of the eastern Pacifi samples and its apparent absence from th western Pacific samples is noteworthy. It i not, however, restricted to the eastern Pacific as it has been reported from Japan (Fukase 1957; Tanaka, 1956a) and from the Dutch Eas Indies (Vervoort, 1946). The other easter Pacific species have also been reported fron these two areas.

### Equatorial undercurrent samples

Four of the fourteen samples examined wer obtained from within the equatorial curren (*Smith* 94, 144, 178, 31). The species compo sition of these samples, when compared wit

mples collected from adjacent waters—north *Smith* 132), south (*Smith* 153), and above *Smith* 30) and below (*Smith* 29) the under-rrent—was not particularly distinctive. *Sco-cithricella tenuiserrata,* although apparently sent from one undercurrent sample (*Smith* 4), did appear in the other three samples and so in two other samples (*Smith* 63, *Stranger* 4) that were collected from depths where the ndercurrent could be located, if present, but veral hundred miles west of its known limits. nauss (1959), has indicated that the current ay extend as far west as about 160° E.; in at event the above two samples could have en collected from the current. Even if *S. nuiserrata* is typically found within the un-ercurrent, it cannot be considered as an "indi-tor" *sensu stricto* of the current. In addi-on to the present samples, this species has en reported from near the Great Barrier eef (Farran, 1936) and from Japan (Tanaka, 53).

umerical abundance

The number of copepods calculated for those llections in which a current meter was em-oyed, varied from 2.3 to 56.4 with a mean of 1.8 copepods per cubic meter (table 2). These ata may be compared to numerical data pre-nted by Brodsky (1952) for the northwestern acific Ocean. Using only those collections in hich closing nets were used (*Smith* 94, 132, 44, 153, 178, and 31), a mean number of 26.8 opepods per cubic meter was calculated for epths between approximately 50 and 150 eters in the eastern Pacific Ocean. Brodsky's ata included numerical abundances for seven different vertical levels. For the 50 to 100–m. level he gave a figure of 5,040 calanoids per cubic meter and for the 100 to 200–m. level, 320 per cubic meter. Nine species were present at the former level and ten at the latter level. In comparison, there were no less than 25 species in any of the aforementioned eastern Pacific closing net samples.

## TAXONOMY

For each species I have given references to its occurrence in the Pacific Ocean, with the exception of those early records summarized by Giesbrecht and Schmeil (1898) and those cited by Vervoort (1946, 1957). The former reference has usually been omitted in the following sections. I have given measurements for several individuals of a species and usually at all stations where it occurred. The total-length measurements are from the tip of the forehead to the end of the furca, without regard to the telescoped portions of the abdominal segments, and are recorded in mm. unless otherwise indicated. Except for *Pseudochirella,* copepodids which could not be assigned to a species are not mentioned.

Included under Remarks are certain taxonomic or ecological notes and usually a few brief statements on the diagnostic characters of the species. It is hoped that the specific characters mentioned and the figures presented for each species will be useful to others making identifications of tropical calanoid copepods. All illustrations were made with a camera lucida.

### Family CALANIDAE

*Calanus tenuicornis* Dana, 1849

Pacific records: Vervoort, 1946. Also, Yamada, 33; Johnson, 1942; Mori, 1942; Davis, 1949; Brodsky, 50; Motoda, Iizuka, and Anraku, 1950; Motoda and nraku, 1951; Anraku, 1952; Honjo, 1952; Motoda and nraku, 1952b; Nakai, 1952; Anraku, 1953; Tanaka, 53; Yamazi, 1953a; 1953c; Anraku, 1954a; 1954b; otoda and Anraku, 1954; Tsuruta and Chiba, 1954a; 54b; Yamazi, 1954b; 1954d; Bowman, 1955; Chiba, suruta, and Maéda, 1955; Motoda and Anraku, 1955; agaya et al., 1955; Yamazi, 1955a; Chiba, 1956; Tanaka, 1956a; Heinrich, 1957a; Honjo et al., 1957; Heinrich, 1958b; Yamazi, 1958a; 1958b; Brodsky, 1959; Lindberg, 1959; Ponomareva, 1959.

| Vessel: | Station | Occurrence |
|---|---|---|
| *Hugh M. Smith* | 94 | 1 female, 1.87 mm.; 1 male, 1.80 mm. |
| Do | 132 | present. |
| Do | 153 | 1 female, 1.75 mm.; 1 male, 1.56 mm. |
| Do | 178 | present. |
| *Horizon* | 32 | 1 female, 1.68 mm. |

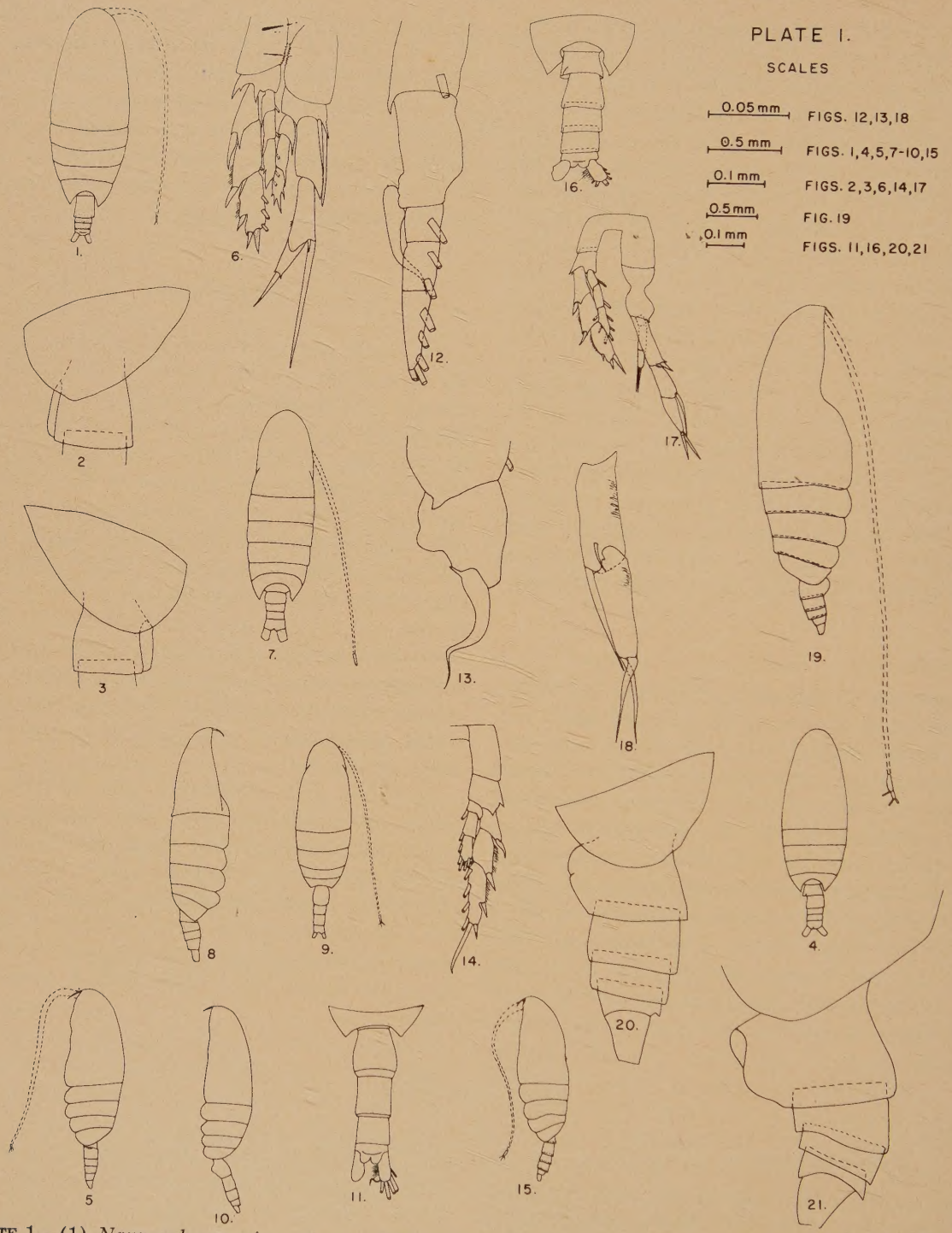


PLATE 1—(1) *Nannocalanus minor*, female, dorsal view; (2) posterior part of thorax and genital segment, left side; (3) posterior part of thorax and genital segment, right side; (4) male, dorsal view; (5) lateral view; (6) fifth pair of feet; (7) stage V female, dorsal view; (8) lateral view; (9) *Canthocalanus pauper*, female, dorsal view; (10) lateral view; (11) posterior part of thorax and abdomen, dorsal view; (12) endopod of first foot, lateral view; (13) first and second basipodal segments of first foot, oblique view; (14) fifth foot; (15) male, lateral view; (16) posterior part of thorax and abdomen, dorsal view; (17) fifth pair of feet; (18) distal two segments of left fifth foot; (19) *Neocalanus gracilis*, female, lateral view; (20) posterior part of thorax and abdomen, lateral view; (21) *Neocalanus robustior*, female, posterior part of thorax and abdomen, lateral view.

Remarks: Most of the present specimens have their furcal setae eroded. Bowman (1955) has previously observed this in specimens collected from the northeastern Pacific. He attributed this erosion to protozoan parasites which were present in the furcae. The majority of my specimens also contain these parasites in the furcae. Bowman (1955) has fully figured *C. lighti*, a species which differs morphologically from *tenuicornis* only in size.

*Nannocalanus minor* (Claus, 1863)

(PLATE 1, FIGS. 1–8)

Pacific records: Vervoort, 1946. Also, as *Calanus minor;* Yamada, 1933a; Mori, 1937; 1942; Wilson, 1942; Anraku, 1952; Chiba, 1952c; Honjo, 1952; Nakai, 1952; Tanaka, 1953; Yamazi, 1953a; 1953b; 1953c; Anraku, 1954b; Motoda and Anraku, 1954; Tsuruta and Chiba, 1954b; Yamazi, 1954b; 1954d; Chiba, Tsuruta, and Maéda, 1955; Hida and King, 1955; Motoda and Anraku, 1955; Nagaya et al., 1955; Yamazi, 1955d; Chiba, 1956; Tanaka, 1956a; Honjo et al., 1957; Yamazi, 1958a. As *Nannocalanus minor;* Wilson, 1950; Brodsky, 1955; Rose, 1955; Heinrich, 1957b; 1958a; Brodsky, 1959.

| Vessel: | Station | Occurrence |
|---|---|---|
| *Hugh M. Smith* | 94 | 1 female, 1.73 mm. |
| Do | 132 | 14 females, 1.56–1.70 mm.; 7 males, 1.39–1.43 mm. |
| Do | 144 | 1 female, 1.73 mm. |
| Do | 153 | 10 females, 1.58–1.67 mm.; 3 males, 1.44–1.46 mm. |
| Do | 178 | 25 females, 1.51–1.65 mm.; 12 males, 1.31–1.51 mm. |
| Do | 31 | 1 female, 1.75 mm. |
| Do | 29 | 1 female, 1.80 mm. |
| Do | 63 | 1 female, 1.80 mm. |
| *Stranger* | 34 | 6 females, 1.53–1.70 mm. |
| *Orsom* | 10 | 2 females, 1.58, 1.61 mm.; 4 males 1.24–1.46 mm. |
| *Horizon* | 32 | 9 females (stage V), 1.53–1.70 mm. |

Remarks: All the above female specimens belong to *N. minor* f. *major* (Sewell, 1929). Although Sewell (1947) has recently recognized two forms of the male (f. *major* and f. *minor*), I was unable to distinguish these forms among the above specimens. Presumably, they are all referable to f. *major* as Vervoort (1946) has reported smaller males (1.20–1.29) from one *Snellius* station (113) in Netherlands East Indies.

*Canthocalanus pauper* (Giesbrecht, 1888)

(PLATE 1, FIGS. 9–18)

Pacific records: Vervoort, 1946. Also, as *Calanus pauper;* Mori, 1937; 1942; Honjo, 1952; Yamazi, 1953a; 1953b; Anraku, 1954b; Johnson, 1954; Tsuruta and Chiba, 1954b; Motoda and Anraku, 1955; Nagaya et al., 1955. As *Canthocalanus pauper;* Wilson, 1942; 1950; Tanaka, 1953; Brodsky, 1955; Rose, 1955; Tanaka, 1956a; Yamazi, 1958a.

| Vessel: | Station | Occurrence |
|---|---|---|
| *Hugh M. Smith* | 63 | 1 female, 1.42 mm. |
| *Stranger* | 34 | 1 male, 1.31 mm. |
| *Orson* | 32 | 2 females, 1.42, 1.46 mm.; 1 male, 1.36 mm. |

Remarks: This small copepod is most easily recognized by the peculiarly shaped spine on the second basipodal segment of the first pair of feet (figs. 12, 13) in the female and the structure of the fifth pair of feet (figs. 17, 18) in the male.

*Neocalanus gracilis* (Dana, 1849)

(PLATE 1, FIGS. 19–20)

Pacific records: Vervoort, 1946; 1957. Also, as *Calanus gracilis;* Mori, 1942; Honjo, 1952; Tsuruta and Chiba, 1954b; Motoda and Anraku, 1955; Nagaya et al., 1955; Chiba, 1956; Honjo et al., 1957. As *Neocalanus gracilis;* Tanaka, 1953; Hida and King, 1955; Tanaka, 1956a; Yamazi, 1958a.

| Vessel: | Station | Occurrence |
|---|---|---|
| *Hugh M. Smith* | 94 | present. |
| Do | 132 | 8 females (stage V), 2.34–2.48 mm. |
| Do | 153 | 1 female, 3.09 mm. |
| Do | 31 | 2 females, 3.33 mm. |
| *Stranger* | 34 | 4 females, 3.01–3.06 mm. |
| *Orsom* | 10 | 1 female, 2.96 mm. |
| *Satsuma* | 32 | 1 female, 2.11 mm. |

Remarks: Vervoort (1946) has listed the differences between this species and *Neocalanus robustior* (Giesbrecht). The adult females of *N. gracilis* are smaller (maximum 3.33) and the genital segment is less produced ventrally (fig. 20). No males were encountered in the present collections.

*Neocalanus robustior* (Giesbrecht, 1888)

(PLATE 1, FIG. 21)

Pacific records: Vervoort, 1946. Also, as *Calanus robustior;* Mori, 1937; Honjo, 1952; Yamazi, 1953a; Tsuruta and Chiba, 1954b; Chiba, Tsuruta, and Maéda, 1955; Nagaya et al., 1955; Chiba 1956; Honjo et al., 1957. As *Neocalanus robustior;* Wilson, 1942; 1950; Tanaka, 1953; Brodsky, 1955; Tanaka, 1956a; Yamazi, 1958a.

| Vessel: | Station | Occurrence |
|---|---|---|
| *Hugh M. Smith* | 153 | 1 female, 4.08 mm. |
| Do | 178 | 1 female, 3.40 mm. |
| Do | 63 | 1 female (stage V), 2.99 mm., 3 females, 3.80–3.89 mm. |
| *Stranger* | 34 | 1 female, 3.61 mm. |

Remarks: The large size (greater than 3.4 mm.) and greatly produced genital segment (fig. 21) of this species distinguishes it from *N. gracilis.* No males were found in the present samples.

*Undinula vulgaris* (Dana, 1849)

Pacific records: Vervoort, 1946. Also, as *Calanus vulgaris;* Yamada, 1933a; Mori, 1937; 1942; Chiba, 1952c; Honjo, 1952; Anraku, 1954b; Tsuruta and Chiba, 1954b; Motoda and Anraku, 1955; Chiba, 1956; Honjo et al., 1957. As *Undinula vulgaris;* Wilson, 1942; Johnson, 1949; Wilson, 1950; Tanaka, 1953; Johnson, 1954; Brodsky, 1955; Hida and King, 1955; Rose, 1955; Tanaka, 1956a; Yamazi, 1958a.

| Vessel: | Station | Occurrence |
|---|---|---|
| *Satsuma* | 32 | 1 male, 2.04 mm. |

Remarks: Both Vervoort (1946) and Wilson (1950) speak of the great abundance of this species in the Netherlands East Indies and near the Hawaiian Islands, respectively. Scott (1909) also found it abundantly in the Malay Archipelago area as did Johnson (1949) in Bikini Lagoon and Tanaka (1956a) in the Izu region of Japan. In view of its extreme scarcity in the present collections, it is apparently more of an insular and nearshore species in contradistinction to *Undinula darwini,* a widespread species in the present collections.

*Undinula darwini* (Lubbock, 1860)

(PLATE 2, FIGS. 1–9)

Pacific records: Vervoort, 1946. Also, as *Calanus darwini;* Yamada, 1933a; Mori, 1937; 1942; Anraku 1952; Honjo, 1952; Nakai, 1952; Yamazi, 1953a; 1953b 1953c; Anraku, 1954b; Chiba and Tsuruta, 1954; Yamazi, 1954b; Motoda and Anraku, 1955; Nagaya et al. 1955; Yamazi, 1955a; 1955d; Chiba, 1956; Honjo et al. 1957; Yamazi, 1958b. As *Undinula darwini;* Wilson 1942; 1950; Tanaka, 1953; Johnson, 1954; Brodsky 1955; Rose, 1955; Tanaka, 1956a; Heinrich, 1957b 1958a; Yamazi, 1958a; 1958b.

Remarks: All female specimens of this species have a group of inwardly projecting spines on the inner sides of the fifth thoracic segment (fig. 1). Also characteristic of this sex is the shape of the genital segment, which in dorsal view, is seen to narrow anteriorly (fig. 1).

The three forms of the female of this species (described by Sewell, 1929) are distinguished by the shape of the left fifth thoracic margin and spinulation of the proximal segments of the first antennae. The right fifth thoracic margin in all three forms is rounded and ha

| Vessel: | Station | Occurrence (measurement in mm.; number of specimens in paren.) | | | |
|---|---|---|---|---|---|
| | | f. *typica* female | f. *symmetrica* female | f. *intermedia* female | male |
| *Hugh M. Smith* | 94 | | | | (1) |
| Do | 132 | | 1.97(1) | | |
| Do | 144 | 1.90(1) | 1.87–2.04(7) | | 1.80(3) |
| Do | 153 | 1.90–2.00(2) | 1.80–1.90(7) | | present. |
| Do | 178 | present | 1.84–1.90(20) | | 1.60–1.67(4) |
| Do | 30 | 2.00(2) | 1.95–2.04(4) | | |
| Do | 31 | 1.90–2.18(2) | 2.00(1) | | (2) |
| Do | 29 | | | | (1) |
| Do | 63 | 1.90(1) | 1.94–2.04(5) | | (8) |
| *Stranger* | 34 | 2.04(1) | 2.04(1) | 2.07(1) | (3) |
| *Orsom* | 10 | | | 1.90(1) | 1.73(1) |
| *Horizon* | 32 | | 2.04(1) | 1.94–2.07(4) | |
| *Satsuma* | 32 | 1.80(1) | | 1.84–1.90(5) | 1.63(1) |

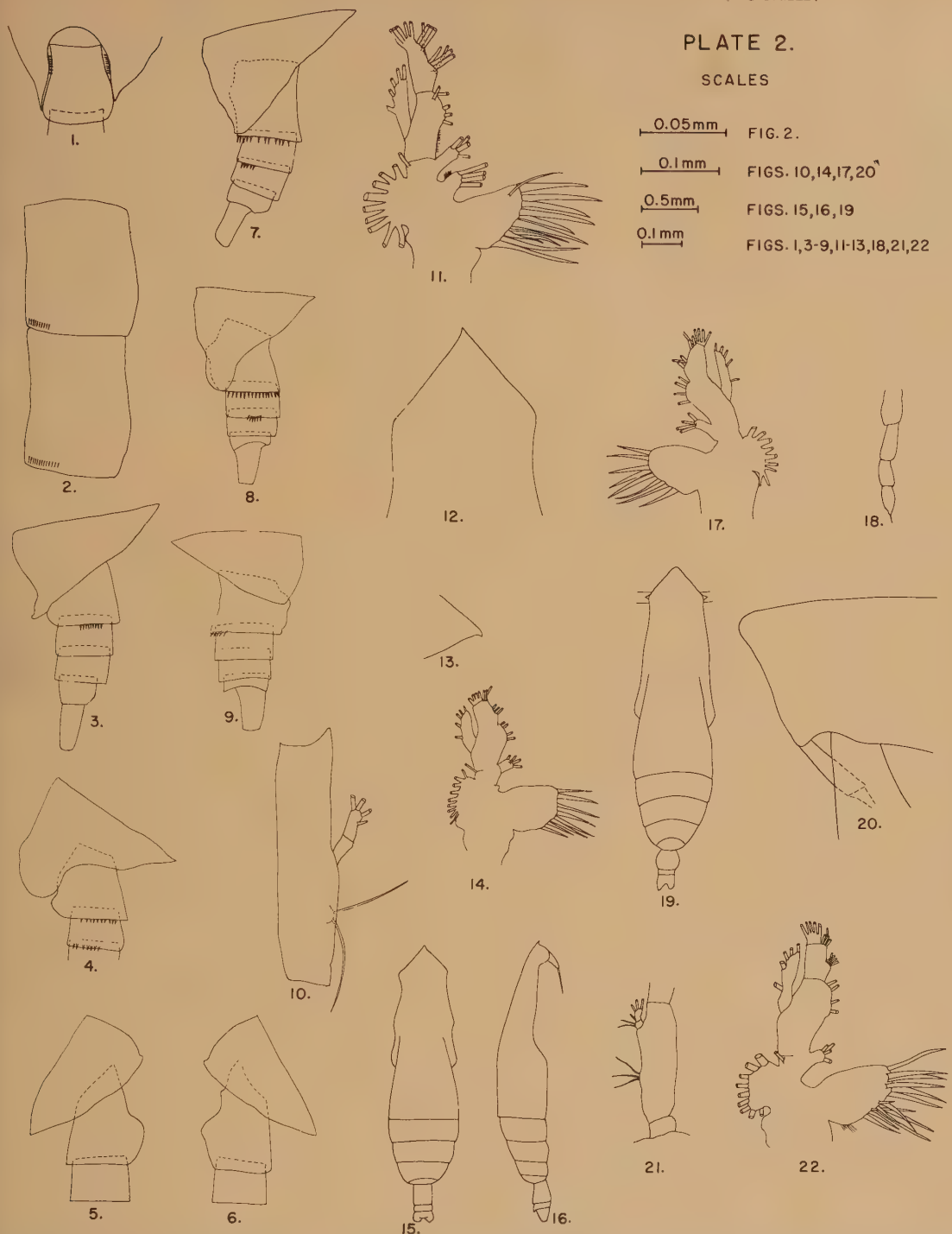


PLATE 2.—(1) *Undinula darwini* f. *typica*, female, posterior part of thorax and genital segment, dorsal view; segments 6 and 7 of first antenna; (3) posterior part of thorax and abdomen, left side; (4) posterior part of rax and abdomen, left side; (5) *U. darwini* f. *symmetrica*, female, posterior part of thorax and genital segment, nt side; (6) posterior part of thorax and genital segment, left side; (7) *U. darwini* f. *intermedia*, female, terior part of thorax and abdomen, left side; (8) posterior part of thorax and abdomen, left side; (9) posterior t of thorax and abdomen, right side; (10) *Eucalanus attenuatus*, female, second basal segment and endopod mandible; (11) first maxilla; (12) *E. mucronatus*, stage IV, female, forehead, dorsal view; (13) forehead, eral view; (14) first maxilla; (15) stage V, male, dorsal view; (16) lateral view; (17) first maxilla; (18) fifth t; (19) *E. subtenuis* var. *japonica*, female, dorsal view; (20) forehead, lateral view; (21) basal segments and opod of mandible; (22) first maxilla.

a small notch. In forma *typica,* both segments 6 and 7 of the first antennae have a row of spinules along the distal margin (fig. 2). The left fifth thoracic margin is somewhat variable in shape. Typically, it is produced into a point which is directed ventrally (fig. 3). In a few individuals this margin was expanded and rounded (fig. 4). In forma *symmetrica,* a row of spinules is also present on segments 6 and 7 of the first antennae, but the two thoracic margins are symmetrical (figs. 5, 6). In forma *intermedia,* spinules are present on segments 3 through 7 of the first antennae, and the left fifth thoracic margin is usually more or less triangular in shape (fig. 7). In several specimens, this margin was rounded similar to th of forma *symmetrica* (fig. 8). Most exampl of forma *intermedia* also had a small gro of spines situated on the left mid-lateral marg of the second abdominal segment.

Chiba (1953a) has recently discussed a presented figures of small (40–60$\mu$) spheric bodies which he detected within the furcae the female of this species. He considered the objects to be eggs and analogized the "e chamber" (furca) to the brood sac of daphnic I too have seen these bodies in the furcae this species. They are possibly protozoan par sites but not the reproductive eggs of t species.

## Family EUCALANIDAE

### *Eucalanus attenuatus* (Dana, 1849)

(PLATE 2, FIGS. 10, 11)

Pacific records: Vervoort, 1946. Also, Yamada, 1933a; Tanaka, 1935a; Mori, 1937; Johnson, 1942; Mori, 1942; Wilson, 1942; Brodsky, 1950; Wilson, 1950; Anraku, 1952; Honjo, 1952; Tanaka, 1953; Yamazi, 1953c; Anraku, 1954b; Johnson, 1954; Tsuruta and Chiba, 1954b; Yamazi, 1954d; Brodsky, 1955; Chiba, Tsuruta and Maéda, 1955; Hida and King, 1955; Motoda and Anraku, 1955; Nagaya et al., 1955; Rose, 1955; Yamazi, 1955a; 1955d; Chiba, 1956; Tanaka, 1956a; Honjo et al., 1957; Heinrich, 1958a; 1958b; Yamazi, 1958a; Brodsky, 1959; Lindberg, 1959; Ponomareva, 1959.

| Vessel: | Station | Occurrence |
|---|---|---|
| *Hugh M. Smith* | 132 | 1 female, 3.89 mm. |
| Do | 153 | present. |
| Do | 178 | 2 females, 3.61, 3.80 mm.; 1 male, 2.96 mm. |
| Do | 30 | 1 female, 3.16 mm. |
| Do | 31 | 5 males, 2.92–3.06 mm. |
| Do | 63 | 2 females, 3.90, 4.08 mm. |
| *Stranger* | 34 | 1 female, 3.06 mm. |
| *Horizon* | 32 | 7 females, 3.90–4.28 mm.; 1 female (stage V) 3.20 mm. |

Remarks: Vervoort (1946) noted that there were large variations in the sizes of his specimens (females, 3.55–5.80; males 2.95–4.35) from the Netherlands East Indies, but he could find no anatomical differences between the si groups. Tanaka (1956a) likewise observ that there were large size variations (fema 4.32–6.19; male, 3.24–4.67) in the lengths specimens obtained from the Izu region Japan. He reported differences (shape of ge tal segment, presence of hair on female, re tive lengths of segments of fifth pair of feet the male) between the larger specimens of th species and suggested that a northern varie may have been present. The lengths of t present specimens were not nearly so variab as those reported by Vervoort or Tanaka.

### *Eucalanus mucronatus* Giesbrecht, 1888

(PLATE 2, FIGS. 12–18)

Pacific records: Vervoort, 1946; 1957. Also, Y mada, 1933; Tanaka, 1935a; Honjo, 1952; Nakai, 195 Tanaka, 1953; Yamazi, 1953a; Anraku, 1954b; Chi Tsuruta, and Maéda, 1955; Motoda and Anraku, 195 Nagaya et al., 1955; Tanaka, 1956a; Honjo et al., 195 Yamazi, 1958a; 1958b.

| Vessel: | Station | Occurrence |
|---|---|---|
| *Horizon* | 32 | 1 female (stage IV 2.07 mm.; 1 m (stage V), 2.5 mm. |

Remarks: Juveniles of this species we found in one collection. They are easily reco nized by the pointed forehead, which is prese in both sexes.

*Eucalanus subtenuis* Giesbrecht, 1888

(PLATE 2, FIGS. 19–21; PLATE 3, FIGS. 1–4)

Pacific records: Vervoort, 1946. Also, Mori, 1937; naka, 1935a; Johnson, 1942; Mori, 1942; Wilson, 42; 1950; Tanaka, 1953; 1956a; Fukase, 1957; Honjo al., 1957; Heinrich, 1958b.

| ssel: | Station | Occurrence |
|---|---|---|
| *Hugh M. Smith* | 94 | 1 female, 3.12 mm. |
| Do | 132 | 13 females, 2.55–2.96 mm. |
| Do | 144 | 10 females, 2.40–2.60 mm. |
| Do | 153 | present. |
| Do | 178 | 15 females, 2.65–2.72 mm.; 6 males, 2.45–2.52 mm. |
| Do | 31 | 15 females, 2.55–2.79 mm. |
| Do | 63 | 16 females, 2.69–2.96 mm.; 1 male, 2.51 mm. |

Remarks: All of the present specimens are ferable to *E. subtenuis* var. *japonica* Fukase, 57. This variety is distinguished from *sub-nuis* chiefly by the number of setae on the andibular palpus (both sexes) and the struc-re of the fifth feet of the male. There are setae on the mandibular palpus (fig. 21; fig. and the distal segment of the fifth foot is nger than the terminal spine (fig. 4). In *btenuis* there are 2 setae on the mandibular lpus and the terminal spine of the fifth foot longer than the distal segment.

According to Fukase, Tanaka's (1935a) *E. btenuis* and Mori's (1937) *E. mucronatus* are th referable to *subtenuis* var. *japonica*.

This species was present in seven of the mples and in four of these (*Smith* 132, 144, 8, 63) it was the most abundant species.

*Eucalanus pileatus* Giesbrecht, 1888

(PLATE 3, FIGS. 5–12)

Pacific records: Scott, 1909; Tanaka, 1935a; Wilson, 50; Tanaka, 1953; 1956a.

| ssel: | Station | Occurrence |
|---|---|---|
| *Satsuma* | 32 | 2 females, 1.80 and 1.94 mm. |

Remarks: This species closely resembles *E. bcrassus* and the two may prove to be con-ecific. Until a detailed study is made of each, it seems best to keep them separate. The females may be distinguished as follows (Pacific specimens):

1. Size. *E. pileatus*, 1.80–2.41; *E. subcrassus*, 2.23–2.82. (length data from Tanaka, 1935a; Mori, 1937; Vervoort, 1946; and present data). Farran (1936) has reported *E. subcrassus* with total lengths of 1.84–2.92 from the Great Barrier Reef. He did not record *E. pileatus*.

2. Shape of forehead. In dorsal view anterior end of forehead more produced in *E. pileatus* (fig. 7) than in *E. subcrassus* (plate 3, fig. 15).

3. Shape of genital segment. *E. pileatus*, greatest diameter at a point approximately one-half the length of the segment (fig. 10); *E. subcrassus*, greatest diameter in lower third of segment (plate 3, fig. 16).

*Eucalanus subcrassus* Giesbrecht, 1888

(PLATE 3, FIGS. 13–17)

Pacific records: Vervoort, 1946. Also, Tanaka, 1935a; Mori, 1937; 1942; Wilson, 1950; Anraku, 1952; Honjo, 1952; Tanaka, 1953; Anraku, 1954b; Tsuruta and Chiba, 1954b; Brodsky, 1955; Chiba, Tsuruta, and Maéda, 1955; Motoda and Anraku, 1955; Nagaya et al., 1955; Rose, 1955; Tanaka, 1956a; Honjo et al., 1957; Yamazi, 1958a.

| Vessel: | Station | Occurrence |
|---|---|---|
| *Hugh M. Smith* | 63 | 3 females, 2.44–2.52 mm. |
| *Stranger* | 34 | 3 females, 2.24–2.48 mm. |
| *Orsom* | 10 | 4 females, 2.31–2.48 mm., 3 males (stage V), 2.11–2.18 mm. |

Remarks: Vervoort (1946) stated that there are 4 setae on the second basal joint of the first maxilla. The present specimens, however, have 5 (fig. 17).

*Rhincalanus cornutus* (Dana, 1849)

(PLATE 3, FIGS. 18–19)

Pacific records: Vervoort, 1946. Also, Yamada, 1933; Tanaka, 1935a; Mori, 1937; 1942; Wilson, 1942; 1950; Honjo, 1952; Tanaka, 1953; Anraku, 1954b; Tsuruta and Chiba, 1954b; Chiba, Tsuruta and Maéda, 1955; Hida and King, 1955; Nagaya et al., 1955; Rose, 1955;

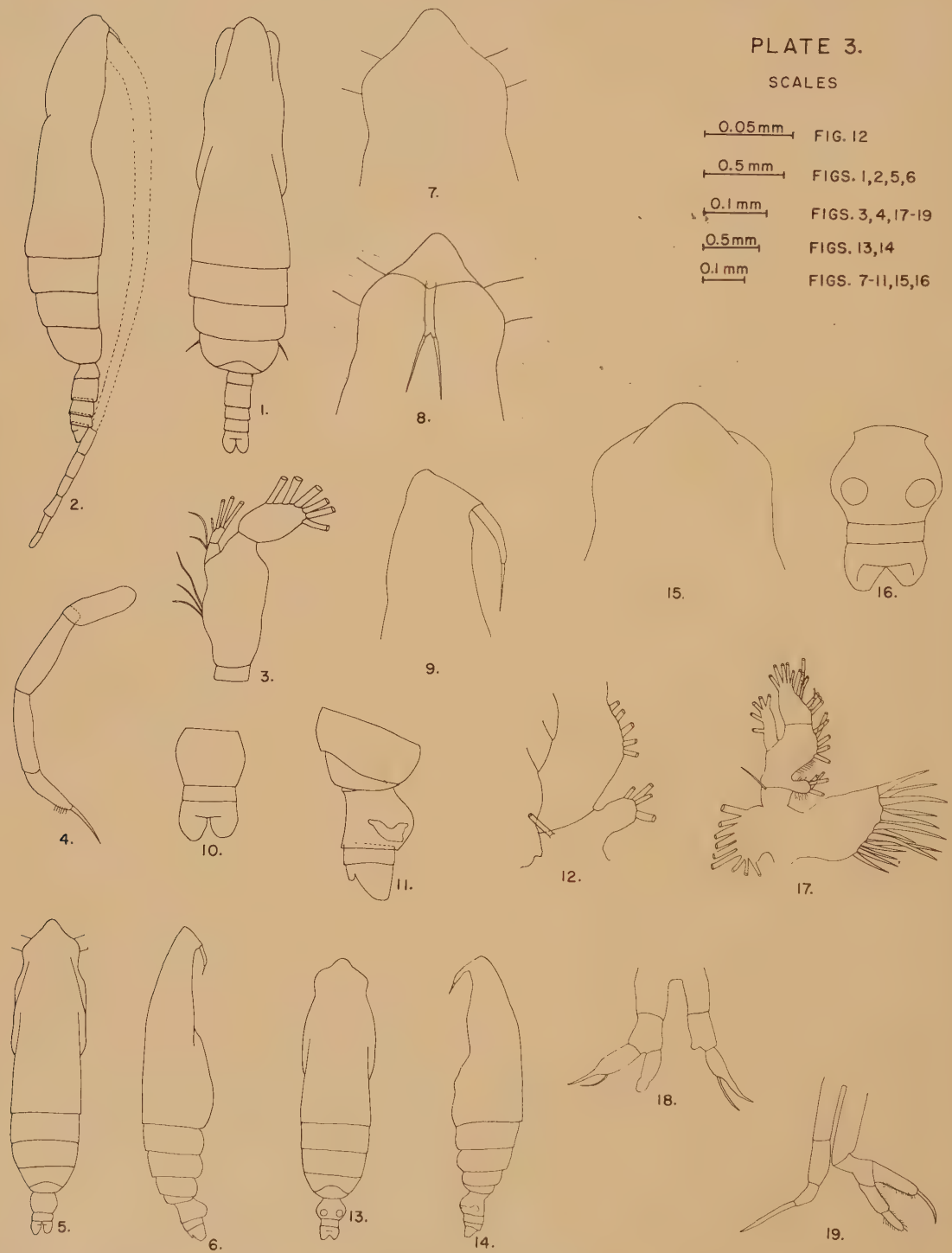


PLATE 3.—(1) *Eucalanus subtenuis* var. *japonica*, male, dorsal; (2) lateral; (3) mandible palpus; (4) fifth foot; (5) *E. pileatus*, female, dorsal view; (6) female, lateral view; (7) forehead, dorsal view; (8) forehead, ventral view; (9) forehead, lateral view; (10) abdomen, dorsal view; (11) posterior part of thorax and abdomen, lateral view; (12) first maxilla (part); (13) *E. subcrassus*, female, dorsal view; (14) lateral view; (15) forehead, dorsal view; (16) abdomen, dorsal view; (17) first maxilla; (18) *Rhincalanus cornutus*, stage V, male, fifth pair of feet; (19) adult male, fifth pair of feet.

Chiba, 1956; Tanaka, 1956a; Honjo et al., 1957; Yamazi, 1958a.

| Vessel: | Station | Occurrence |
|---|---|---|
| *Hugh M. Smith* | 94 | 2 females, 2.79, 3.20 mm. |
| Do | 144 | 1 female, 3.09 mm. |
| Do | 153 | 1 male, 2.89 mm. |
| Do | 31 | 2 females, 3.33; 2 males (stage V), 2.70, 2.80 mm. |
| Do | 29 | 18 females, 3.20–3.33 mm.; 6 males, 2.79–2.86 mm. |
| Do | 63 | 3 females, 3.09–3.24 mm. |
| *Stranger* | 34 | 1 female, 3.09 mm. |
| *Orsom* | 10 | 2 males, 2.69, 2.72 mm. |
| *Horizon* | 32 | 2 females, 3.40 mm.; 1 male (stage V), 2.52 mm. |
| *Satsuma* | 32 | 1 male, 2.95 mm. |

Remarks: All of the above females belong to *R. cornutus* f. *typica* Schmaus. This species was widely distributed in the samples.

*Rhincalanus nasutus* Giesbrecht, 1888

Pacific records: Vervoort, 1946; 1957. Also, Yamada, 1933; Tanaka, 1935a; Johnson, 1942; Brodsky, 1950; Anraku, 1952; Honjo, 1952; Tanaka, 1953; Anraku, 1954b; 1954c; Chiba and Tsuruta, 1955; Tanaka, 1956a; Honjo et al., 1957; Heinrich, 1958a; Yamazi, 1958a.

| Vessel: | Station | Occurrence |
|---|---|---|
| *Hugh M. Smith* | 94 | 4 females, 4.08–4.37 mm. |

Remarks: This species occurred in but one sample which was collected in the eastern Pacific by a closing net at a depth between 146 and 172 meters. As Vervoort (1946) mentioned, it is primarily a subsurface species.

## Family PARACALANIDAE

*Paracalanus aculeatus* Giesbrecht, 1888

(PLATE 4, FIGS. 1–3)

Pacific records: Vervoort, 1946; 1957. Also, Yamada, 1933a; 1933b; Mori, 1942; Anraku, 1952; Chiba, 1952a; 1952b; Honjo, 1952; Nakai, 1952; Anraku, 1953; Tanaka, 1953; Yamazi, 1953c; Anraku, 1954b; Tsuruta and Chiba, 1954b; Chiba, Tsuruta, and Maéda, 1955; Motoda and Anraku, 1955; Nagaya et al., 1955; Rose, 1955; Chiba, 1956; Tanaka, 1956b; Honjo et al., 1957; Yamazi, 1958a.

| Vessel: | Station | Occurrence |
|---|---|---|
| *Hugh M. Smith* | 144 | 1 female, 1.0 mm. |
| Do | 153 | 2 females, 1.09, 1.17 mm. |
| Do | 178 | 2 females, 1.10 mm. |
| Do | 31 | 1 female, 1.10 mm. |
| Do | 63 | 9 females, 1.04–1.16 mm. |
| *Stranger* | 34 | 4 females, 1.07–1.17 mm. |
| *Orsom* | 10 | 3 females, 1.07–1.12 mm. |
| *Horizon* | 32 | 2 females, 1.05, 1.10 mm. |

Remarks: All the present specimens belong to *P. aculeatus* f. *major* Sewell, 1929. It was widely distributed in the present collections, but no males were observed.

*Paracalanus parvus* (Claus, 1863)

Pacific records: Vervoort, 1946; 1957. Also, Mori, 1942; Lowe, 1936; Chiba, 1949; Kokubo, 1950; Yamazi, 1950; 1951; Anraku, 1952; Honjo, 1952; Motoda and Anraku, 1952a; Yamazi, 1952a; 1952b; 1952c; Anraku, 1953; Tanaka, 1953; Yamazi, 1953a; 1953b; 1953c; Anraku, 1954a; 1954b; Tsuruta and Chiba, 1954b; Yamazi, 1954a; 1954b; 1954c; 1954d; 1954e; Chiba, Tsuruta, and Maéda, 1955; Motoda and Anraku, 1955; Nagaya et al., 1955; Nakai, 1955; Rose, 1955; Yamazi, 1955a; 1955b; 1955c; 1955d; Chiba, 1956; Shen and Bai, 1956; Tanaka, 1956b; Honjo et al., 1957; Légaré, 1957; Yamazi, 1957; 1958a; 1958b; Brodsky, 1959; Lindberg, 1959.

| Vessel: | Station | Occurrence |
|---|---|---|
| *Hugh M. Smith* | 94 | 2 females, 0.99 mm. |

Remarks: Although this is a cosmopolitan species, it was observed in but one sample. Possibly its small size permitted most of the specimens to pass through the meshes of the nets employed or perhaps it is not too abundant in the waters sampled.

*Paracalanus dubia* Sewell, 1912

(PLATE 4, FIGS. 4–12)

Pacific records: Rose, 1955.

| Vessel: | Station | Occurrence |
|---|---|---|
| *Kagoshima* | 613 | 1 female, 0.49 mm. |

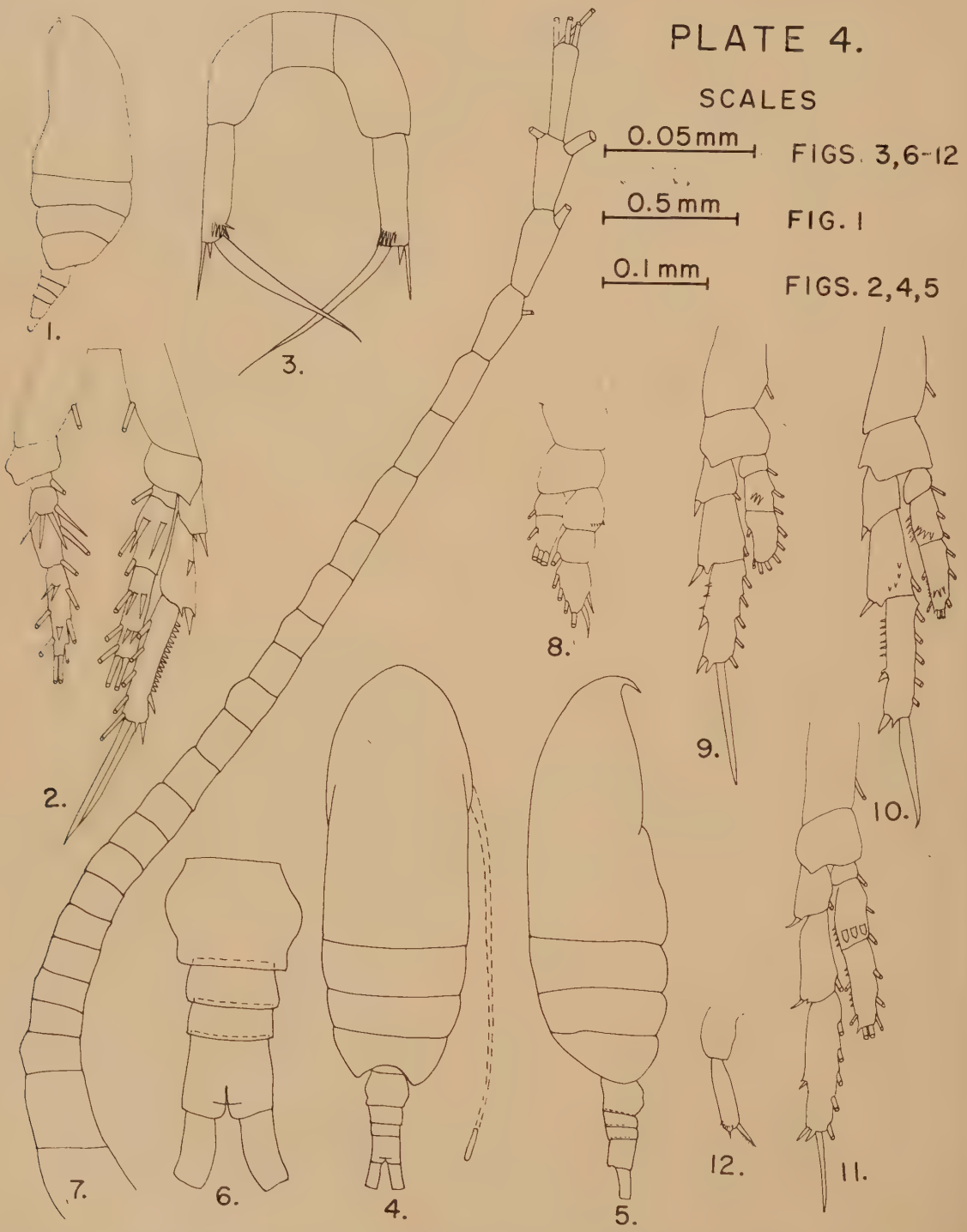


PLATE 4.—(1) *Paracalanus aculeatus*, female, lateral view; (2) fourth pair of feet (one exopod missing) (3) fifth pair of feet; (4) *P. dubia*, female, dorsal view; (5) lateral view; (6) abdomen, dorsal view; (7) first antenna; (8) first foot; (9) second foot; (10) third foot; (11) fourth foot; (12) fifth foot.

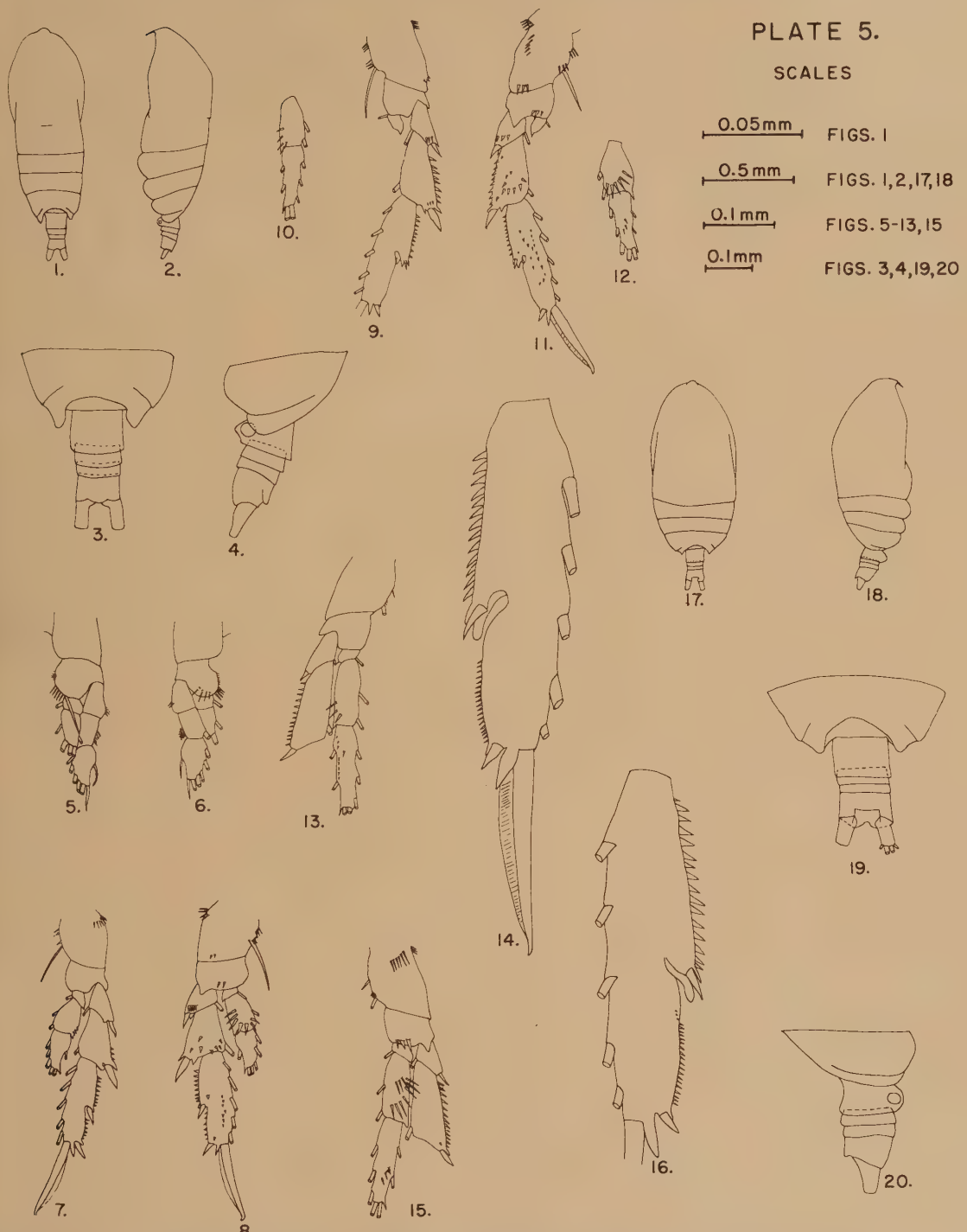


PLATE 5.—(1) *Acrocalanus longicornis*, female, dorsal view; (2) lateral view; (3) posterior part of thorax nd abdomen, dorsal view; (4) posterior part of thorax and abdomen, lateral view; (5) first foot, anterior; (6) first oot, posterior; (7) second foot, anterior; (8) second foot, posterior; (9) third foot, anterior, without distal 2 gments of endopod; (10) distal 2 segments of endopod of third foot, anterior; (11) third foot, posterior, without stal 2 segments of endopod; (12) distal 2 segments of endopod, posterior; (13) fourth foot, anterior, without ird exopodal segment; (14) third exopodal segment of fourth foot, anterior; (15) fourth foot, posterior, without ird exopodal segment; (16) third exopodal segment of fourth foot, posterior; (17) *A. andersoni*, female, dorsal ew; (18) lateral view; (19) posterior part of thorax and abdomen, dorsal view; (20) posterior part of thorax nd abdomen, lateral view.

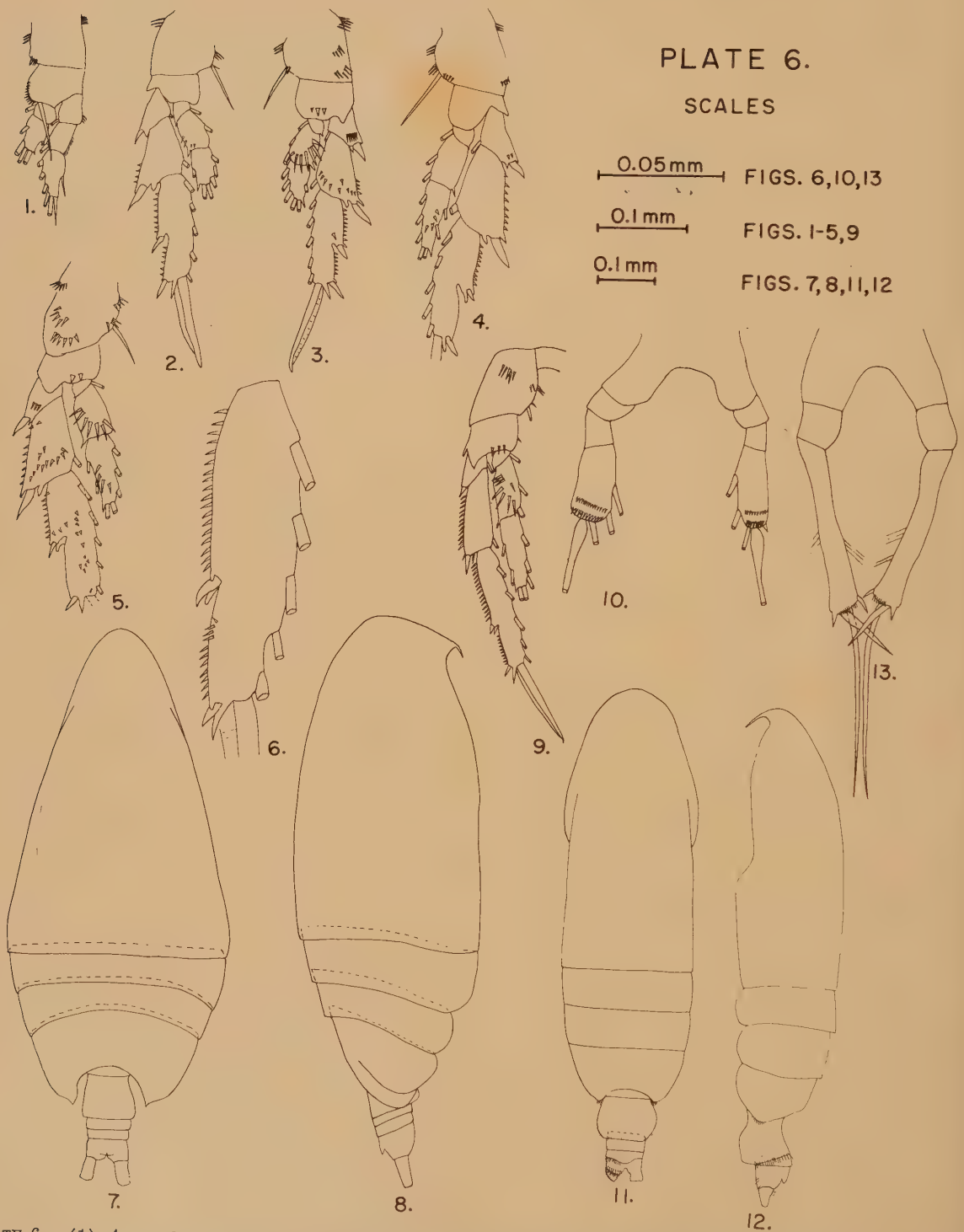


PLATE 6.—(1) *Acrocalanus andersoni*, first foot, anterior; (2) second foot, anterior; (3) second foot, posterior; (4) third foot, anterior; (5) third foot, posterior; (6) third exopodal segment of fourth foot, posterior; (7) *A. monachus*, female, dorsal view; (8) lateral view; (9) fourth foot, posterior; (10) *Calocalanus pavo*, female, fifth pair of feet; (11) *C. plumulosus*, female, dorsal view; (12) lateral view; (13) fifth pair of feet.

Remarks: The forehead of the present specimen as well as the spination of certain of the first four pairs of swimming feet differ somewhat from Sewell's description. The fifth pair of feet of Sewell's *P. serratipes* are similar to those of *P. dubia* but the former is a larger species (1.10 mm.).

The small spinules on the distal end of the terminal segment of the fifth feet can best be seen under oil immersion. The other feet, except the first pair, were also examined under oil in order to ascertain the number of setae, surface spines and lateral teeth on the various segments.

Only one specimen was obtained and this was partly destroyed in the process of dissection.

*Acrocalanus longicornis* Giesbrecht, 1888

(PLATE 5, FIGS. 1–16)

Pacific records: Vervoort, 1946. Also, Yamada, 1933; Mori, 1937; 1942; Wilson, 1942; 1950; Tanaka, 1953; Tsuruta and Chiba, 1954b; Chiba, Tsuruta and Maéda, 1955; Nagaya et al., 1955; Rose, 1955; Yamazi, 1955a; Tanaka, 1956b; Honjo et al., 1957; Yamazi, 1958a.

| Vessel: | Station | Occurrence |
|---|---|---|
| *Hugh M. Smith* | 153 | 2 females, 1.20, 1.22 mm. |
| Do | 31 | 1 female, 1.26 mm. |
| Do | 63 | 2 females, 1.19, 1.24 mm. |
| *Stranger* | 34 | 7 females, 1.17–1.27 mm. |

Remarks: The presence of a partial suture between the head and first thoracic segment (figs. 1, 2) and the spination of the swimming feet, particularly the number of teeth (more than 18) on the distal part of the third exopodal segment of the fourth pair of feet (figs. 14, 16), distinguished this species from others in the genus.

*Acrocalanus andersoni* Bowman, 1958

(PLATE 5, FIGS. 17–20; PLATE 6, FIGS. 1–6)

Pacific records: None.

| Vessel: | Station | Occurrence |
|---|---|---|
| *Stranger* | 34 | 1 female, 0.95 mm. |
| *Orsom* | 10 | 3 females, 1.12–1.17 mm. |
| *Kagoshima* | 613 | 1 female, 1.12 mm. |

Remarks: This species was recently described from specimens obtained from the south Atlantic coast of the United States (Bowman, 1958). It is recognized by the lack of partial suture between the head and first thoracic segment (figs. 17, 18) and the number of lateral teeth (11) on the distal part of the third exopodal segment of the fourth pair of feet (fig. 6).

*Acrocalanus monachus* Giesbrecht, 1888

(PLATE 6, FIGS. 7–9)

Pacific records: Scott, 1909; Farran, 1936; Mori, 1937; 1942; Wilson, 1942; 1950; Tanaka, 1953; Tsuruta and Chiba, 1954b; Chiba, Tsuruta, and Maéda, 1955.

| Vessel: | Station | Occurrence |
|---|---|---|
| *Stranger* | 34 | 2 females, 1.02, 1.05 mm. |
| *Orsom* | 10 | 1 female, 1.00 mm. |
| *Horizon* | 32 | 3 females, 1.00–1.10 mm. |

Remarks: The truncate appearance of this species in lateral view (fig. 8) readily distinguishes it from others in the genus.

*Calocalanus pavo* (Dana, 1849)

(PLATE 6, FIG. 10)

Pacific records: Vervoort, 1946. Also, Yamada, 1933a; Mori, 1937; Johnson, 1942; Mori, 1942; Wilson, 1942; 1950; Tanaka, 1953; Yamazi, 1953b; 1953c; Johnson, 1954; Tsuruta and Chiba, 1954b; Yamazi, 1954d; Brodsky, 1955; Chiba, Tsuruta, and Maéda, 1955; Nagaya et al., 1955; Rose, 1955; Yamazi, 1955d; Chiba, 1956; Tanaka, 1956b; Heinrich, 1957b; Honjo et al., 1957; Heinrich, 1958b; Yamazi, 1958a; 1958b.

| Vessel: | Station | Occurrence |
|---|---|---|
| *Hugh M. Smith* | 153 | 1 female, 0.85 mm. |
| Do | 63 | 1 female, 1.00 mm. |
| *Stranger* | 34 | 1 female, 1.19 mm. |
| *Orsom* | 10 | 1 female, 0.97 mm. |
| *Horizon* | 32 | 1 female, 1.00 mm. |

Remarks: Bernard (1958) has recently revised the genus *Calocalanus* based on material collected in the Bay of Algiers. She proposed the family Calocalanidae, which consists of the genus *Calocalanus* s. str. and two new genera, *Leptocalanus* and *Dolichocera*. She has also

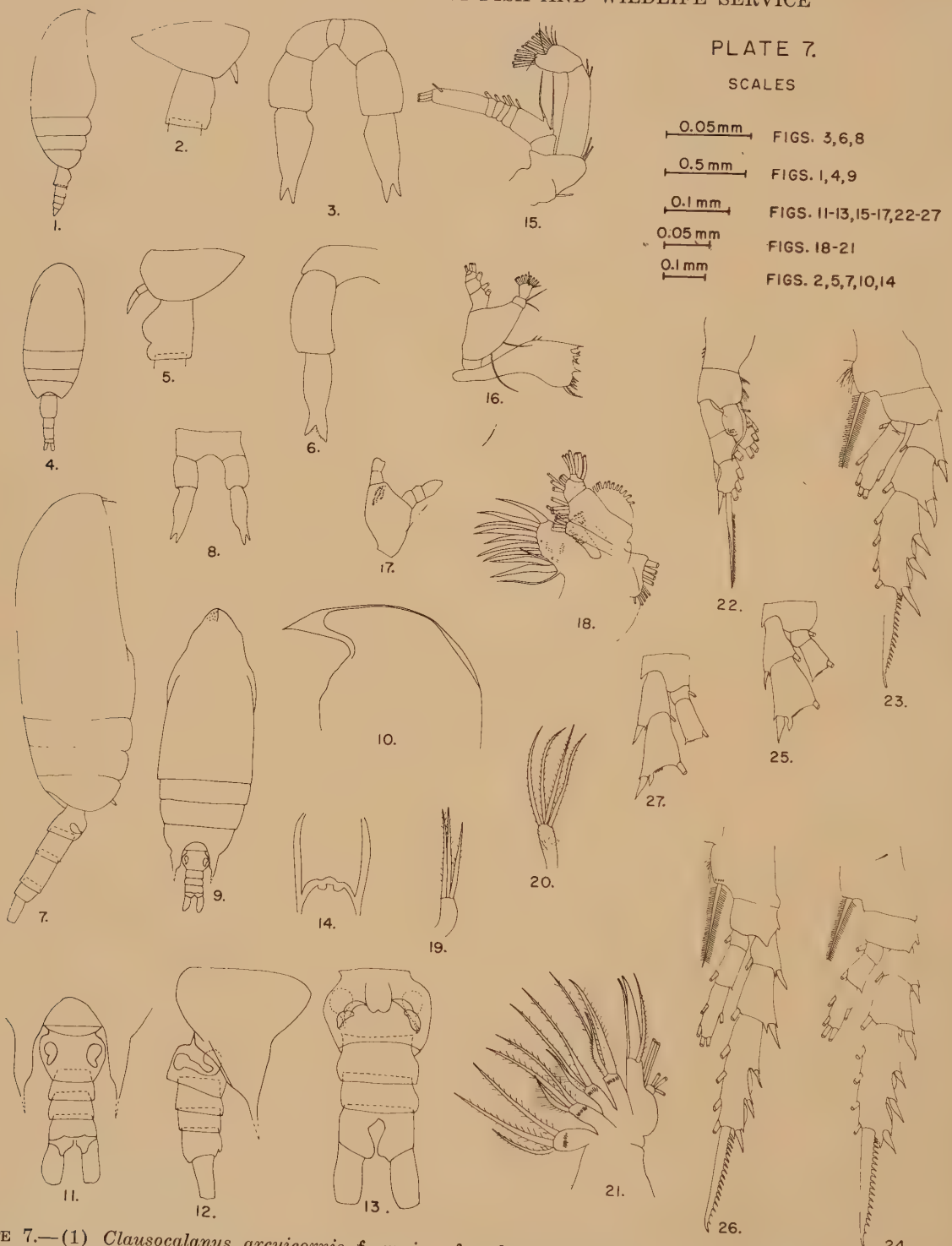


PLATE 7.—(1) *Clausocalanus arcuicornis* f. *major*, female, lateral view; (2) posterior part of thorax and genital segment, lateral view; (3) fifth pair of feet; (4) *C. arcuicornis* f. *minor*, female, dorsal view; (5) posterior part of thorax and genital segment, lateral view; (6) fifth foot; (7) *C. furcatus*, female, lateral view; (8) fifth pair of feet; (9) *Euaetideus giesbrechti*, female, dorsal view; (10) forehead, lateral view; (11) posterior part of thorax and abdomen, dorsal view; (12) posterior part of thorax and abdomen, lateral view; (13) abdomen, ventral view; (14) rostrum; (15) second antenna; (16) mandible; (17) mandible palpus (other side); (18) first maxilla; (19) second inner lobe of first maxilla; (20) third inner lobe of first maxilla; (21) second maxilla; (22) first foot, anterior; (23) second foot, posterior; (24) third foot, posterior; (25) second basipodal segment and first and second segments of endopod and exopod of third foot, anterior; (26) fourth foot, posterior; (27) second basipodal segment and first and second segments of endopod and exopod of fourth foot, anterior.

described two new species and presented descriptions of five hitherto unknown males. *Calocalanus gracilis* Tanaka, 1956, is not included in her revision.

*Calocalanus plumulosus* (Claus, 1863)

(PLATE 6, FIGS. 11–13)

Pacific records: Scott, 1909; Farran, 1929; 1936; Dakin and Colefax, 1940; Mori, 1942; Wilson, 1942; Anraku, 1953; Tanaka, 1953; Tanaka, 1956b; Heinrich, 1957b; 1958b; Yamazi, 1958a.

| Vessel: | Station | Occurrence |
|---|---|---|
| *Satsuma* | 32 | 2 females, 0.87 mm. |

Remarks: According to Bernard's revision (see Remarks under preceding species), this species belongs to a new genus, *Leptocalanus*. The descriptions presented by Tanaka (1956b) and Bernard (1958) of the male are quite different and the two are not unispecific.

Family PSEUDOCALANIDAE

*Clausocalanus arcuicornis* (Dana, 1849)

(PLATE 7, FIGS. 1–6)

Pacific records: Vervoort, 1946; 1957. Also, Yamada, 1933; Johnson, 1942; Mori, 1942; Brodsky, 1950; Nakai, 1952; Anraku, 1954b; Tsuruta and Chiba, 1954b; Brodsky, 1955; Chiba, Tsuruta, and Maéda, 1955; Motoda and Anraku, 1955; Nagaya et al., 1955; Rose, 1955; Chiba, 1956; Tanaka, 1956b; Heinrich, 1957b; Honjo et al., 1957; Heinrich, 1958a; Yamazi, 1958a; Brodsky, 1959; Lindberg, 1959; Ponomareva, 1959.

| Vessel: | Station | Occurrence (*measurement in mm.; number of specimens in paren.*) | | |
|---|---|---|---|---|
| | | f. *minor*, female | f. *major*, female | male |
| *Hugh M. Smith* | 94 | 1.26–1.29(2) | | |
| Do | 132 | 1.07–1.24(17) | | |
| Do | 144 | present | 1.34–1.46(8) | present. |
| Do | 153 | 1.15–1.25(4) | 1.37(1) | |
| Do | 178 | 1.08–1.28(21) | 1.33(1) | |
| Do | 30 | | 1.43–1.56(14) | 1.21–1.26(2) |
| Do | 31 | 1.19–1.31(4) | 1.42–1.53(5) | |
| Do | 63 | 1.33(1) | 1.51(1) | |
| *Stranger* | 34 | 1.16–1.28(10) | | |
| *Orsom* | 10 | 1.16–1.24(13) | 1.53(1) | |
| *Horizon* | 32 | 1.14–1.24(6) | 1.30–1.46(2) | |
| *Satsuma* | 32 | 1.08–1.12(3) | | |

Remarks: I have tentatively equated the females of this species to two forms which were described by Sewell, 1929. The two forms are distinguished by size and the total and relative lengths of the segments of the fifth feet. Forma *major* is large (1.30–1.60 mm.), and the fifth pair of feet is small (fig. 2). The distal segment is about twice as long as the proximal one (fig. 3). Forma *minor* is distinguished by its small size and its longer fifth feet (fig. 5). The distal and proximal segments are about equal in length.

Tanaka (1956b) has described two types of males of this species which differ in size and in the structure of the fifth feet. Although rare in the present collections, males with fifth feet referable to Tanaka's large form were found in the sample from the *Hugh M. Smith*, station 30.

*Clausocalanus furcatus* (Brady, 1883)

(PLATE 7, FIGS. 7–8)

Pacific records: Vervoort, 1946. Also, Mori, 1937; 1942; Wilson, 1942; Brodsky, 1950; Wilson, 1950; Nakai, 1952; Anraku, 1953; Tanaka, 1953; Yamazi, 1953c; Anraku, 1954b; Tsuruta and Chiba, 1954b; Motoda and Anraku, 1955; Nagaya et al., 1955; Rose, 1955; Chiba, 1956; Tanaka, 1956b; Honjo et al., 1957; Heinrich, 1958a.

| Vessel: | Station | Occurrence |
|---|---|---|
| *Hugh M. Smith* | 132 | present. |
| Do | 153 | present. |

| Vessel: | Station | Occurrence |
|---|---|---|
| Do | 178 | 2 females, 1.10, 1.12 mm. |
| Do | 31 | 1 female, 1.14 mm. |
| Do | 63 | 5 females, 1.00–1.17 mm. |
| *Stranger* | 34 | 4 females, 1.12–1.19 mm. |
| *Horizon* | 32 | 3 females, 1.02–1.19 mm. |
| *Satsuma* | 32 | 1 female, 1.05 mm. |

Remarks: This species is easily distinguished from the preceding by its short genital segment (fig. 7) and very small fifth feet (figs. 7, 8).

## Family AETIDEIDAE

### *Euaetideus giesbrechti* (Cleve, 1904)

(PLATE 7, FIGS. 9–27)

Pacific records: Vervoort, 1957. Also, as *Aetideus giesbrechti;* Johnson, 1942; Mori, 1942; Honjo, 1952; Anraku, 1954b; 1954c; Chiba, Tsuruta, and Maéda, 1955; Motoda and Anraku, 1955; Nagaya et al., 1955; Chiba, 1956; Honjo et al., 1957; Tanaka, 1957a; Yamazi, 1958a. As *Euaetideus giesbrechti*; Heinrich, 1957b; 1958a; 1958b.

| Vessel: | Station | Occurrence |
|---|---|---|
| *Hugh M. Smith* | 94 | 1 female, 1.95 mm. |
| Do | 144 | 1 female, 1.95 mm. |
| Do | 29 | 1 female, 1.97 mm. |
| Do | 63 | 2 females, 1.97 mm. |

Remarks: Vervoort (1957) has recently described a new species of *Euaetideus* (*E. australis*) as well as redescribed and figured the other three species (*E. giesbrechti, E. bradyi, E. acutus*) in this genus. The latter three species were represented in the present collections and as all three of them differ in a few details from Vervoort's descriptions, I have included a brief discussion and several figures of each of them. The chief differences between my specimens of *E. giesbrechti* and those described by Vervoort are listed below. The numbers in parenthesis are those given by Vervoort.

1. Second antennae (fig. 15). Four (3) setae on distal segment of exopod. Seven (6) setae on outer lobe and 9 (8) setae on inner lobe of endopod.

2. First maxillae (figs. 18–20). Second basal segment with 4 (5) setae. Second inner lobe with 3 (2) setae. Three (4) setae on the first segment of the endopod. It should be pointed out that Vervoort stated that the first maxilla of *E. giesbrechti* is like that of *E. australis*. The second basal segment of the first maxilla of the latter species is shown to have 4 setae, which agrees, in this respect, with the number on the present specimens.

The three species found in the present collections are distinguished by the shape of the anterior margin of the head (dorsal view); the character of the rostrum; and the posterior lateral thoracic margins. In *E. giesbrechti* the forehead is evenly rounded and the rostral plate is not visible (fig. 9). There are two small knobs between the rostral spines (fig. 14), and the posterior lateral thoracic margins have a characteristic shape (fig. 12). This species is also larger (1.95–2.00) than the other two.

### *Euaetideus acutus* (Farran, 1929)

(PLATE 8, FIGS. 1–2)

Pacific records: Vervoort, 1957. Also, as *Aetideus acutus;* Tanaka, 1957a.

| Vessel: | Station | Occurrence |
|---|---|---|
| *Hugh M. Smith* | 94 | 5 females, 1.65–1.70 mm. |
| Do | 132 | 2 females, 1.65, 1.70 mm. |
| Do | 144 | 3 females, 1.70 mm. |
| Do | 153 | 1 female, 1.70 mm. |
| Do | 178 | 9 females, 1.55–1.65 mm. |
| Do | 30 | 1 female, 1.61 mm. |
| Do | 31 | 2 females, 1.55, 1.65 mm. |
| Do | 63 | 1 female, 1.60 mm. |
| *Stranger* | 34 | 1 female, 1.60 mm. |

Remarks: Certain differences were noted in the second antennae and first maxillae of the present specimens and the descriptions and figures of these appendages given by Vervoort. These differences are summarized below:

1. Second antennae. Same as that described for *E. giesbrechti.* Vervoort shows 3 setae on the terminal segment of the exopod and 6 setae on the outer lobe and 8 setae on the inner lobe of the endopod.

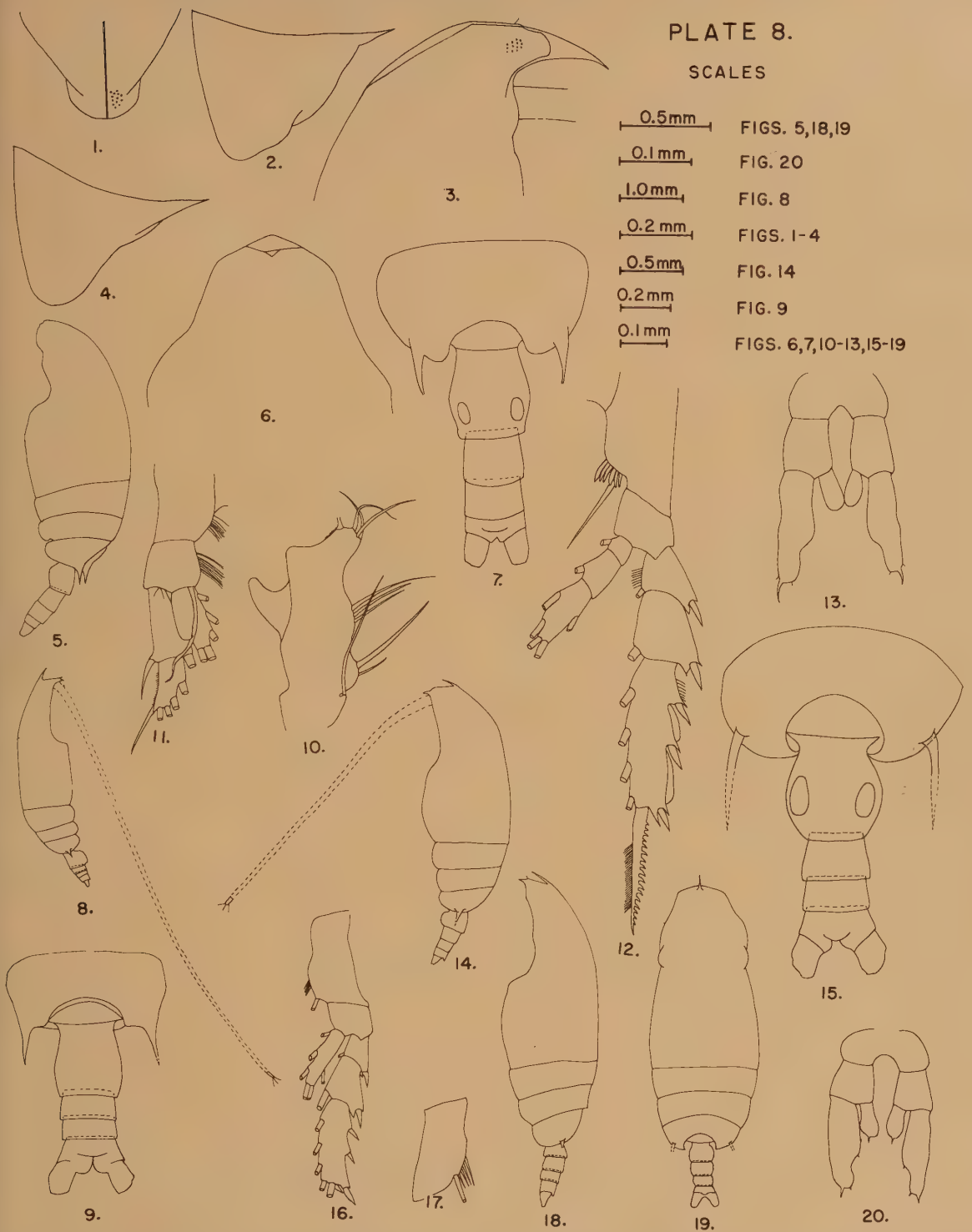


PLATE 8.—(1) *Euaetideus acutus*, female, forehead, dorsal view; (2) fourth and fifth thoracic segments, lateral ew; (3) *E. bradyi*, female, forehead, lateral view; (4) fourth and fifth thoracic segments, lateral view; (5) *iiridius poppei*, female, lateral view; (6) forehead, ventral view; (7) posterior part of thorax and abdomen, rsal view; (8) *Gaetanus miles*, female, lateral view; (9) posterior part of thorax and abdomen, dorsal view; 0) first basipodal segment of maxilliped; (11) first foot; (12) fourth foot; (13) stage V, male, fifth pair of feet; 4) *Gaetanus minor*, female, lateral view; (15) posterior part of thorax and abdomen, dorsal view; (16) second ot; (17) first basipodal segment of fourth foot; (18) stage V, male, lateral view; (19) dorsal view; (20) fifth ir of feet.

2. First maxillae. Same as that described for *E. giesbrechti.* Vervoort shows 5 setae on the second basal segment, 2 setae on the second inner lobe and 4 setae on the first segment of the endopod.

*E. acutus* may be identified by the large rostral plate which is visible in dorsal view (fig. 1) and the character of the posterior lateral thoracic margins (fig. 2).

*Euaetideus bradyi* (A. Scott, 1909)

(PLATE 8, FIGS. 3–4)

Pacific records: Vervoort, 1957; Also, as *Aetideus bradyi;* Tanaka, 1957a.

| Vessel: | Station | Occurrence |
|---|---|---|
| *Hugh M. Smith* | 94 | 12 females, 1.60–1.65 mm. |
| Do | 144 | 3 females, 1.65 mm. |
| Do | 63 | 1 female, 1.70 mm. |

Remarks: The second antennae differ from that figured by Vervoort in the manner described above for *E. giesbrechti.* The first maxilla of the present specimens has 4 setae on the basal segment and 3 setae on the second inner lobe. Vervoort showed 5 and 2 setae, respectively, on these parts of the maxilla. The anterior margin of the head of this species appears to be pitted similar to that of the preceding two species.

*E. bradyi* is distinguished from the above two species by the absence of knobs between the rostral spines and the character of the posterior lateral thoracic margins (fig. 4). In lateral view, a short hair is visible just dorsad of the base of the rostrum. I have not observed this hair in the other two species.

*Chiridius poppei* Giesbrecht, 1892

(PLATE 8, FIGS. 5–7)

Pacific records: Scott, 1909; Farran, 1929; Tanaka, 1937; Wilson, 1942; Brodsky, 1950; Tanaka, 1953; 1957a.

| Vessel: | Station | Occurrence |
|---|---|---|
| *Hugh M. Smith* | 94 | 2 females, 1.59, 1.83 mm. |
| Do | 63 | 1 female, 1.70 mm. |

Remarks: This species was found in two samples collected in the eastern Pacific. Vervoort (1957) suggested that *C. poppei* and *gracilis* Farran, 1905 may represent differe size groups of the same species. He has a indicated how the two forms differ.

*Gaetanus miles* Giesbrecht, 1888

(PLATE 8, FIGS. 8–13)

Pacific records: Scott, 1909; Farran, 1936; Wils 1942; Brodsky, 1950; Tanaka, 1953; 1957b. As *G. cundus* Esterly, 1911; Johnson, 1942.

| Vessel: | Station | Occurrence |
|---|---|---|
| *Hugh M. Smith* | 29 | 2 females, 3.40, 3.5 mm. |
| Do | 63 | 2 females, 3.52 mm 1 male (stage V), 2.89 mm. |

Remarks: The female of this species is eas recognized by the elongate antennae which ceed the furca by the last 9 segments. Acco panying the females in the collection fr *Smith* 63 was an immature male (stage which is apparently referable to this speci The fifth feet are shown in figure 13. T adult male is undescribed, although Este (1911) mentions that he has observed this s presumably in company with the females of *G. secundus* (=*G. miles*).

*Gaetanus minor* Farran, 1905

(PLATE 8, FIGS. 14–20)

Pacific records: Vervoort, 1957. Also, Anra 1954b; 1954c; Tanaka, 1957b; Heinrich, 1958b.

| Vessel: | Station | Occurrence |
|---|---|---|
| *Hugh M. Smith* | 29 | 2 females, 2.18 mm |
| Do | 63 | 2 females, 2.15, 2.2 mm.; 1 male (stage V), 1.8 mm. |
| *Horizon* | 32 | 1 female, 2.00 mm. |

Remarks: The female is distinguished fr *G. miles* by the short antennae and the pr ence of numerous small spines (fig. 17) on first basipodal segment of the fourth feet. R (1933) states that the endopods of the seco feet are composed of 2 segments. These en pods of the present specimens, as well as one figured by Scott (1909), consist of onl segment (fig. 16). Associated with the fema in the collection from *Smith* 63 was a juver

PLATE 9.—(1) *Euchirella bella*, female, dorsal view; (2) lateral view; (3) posterior part of thorax and domen, dorsal view; (4) posterior part of thorax and abdomen, lateral view; (5) endopod of second antenna; first foot; (7) second foot; (8) third foot; (9) fourth foot; (10) male, dorsal view; (11) lateral view; 2) fifth pair of feet; (13) terminal part of left fifth foot; (14) *E. venusta*, female, dorsal view; (15) lateral w; (16) abdomen, dorsal view; (17) abdomen, lateral view; (18) endopod of second antenna; (19) fourth t; (20) male, dorsal view; (21) lateral view; (22) abdomen, dorsal view; (23) second antenna; (24) fifth pair feet; (25) terminal part of left fifth foot.

male (stage V), which is apparently referable to this species (figs. 18–20). The male of this species has been hitherto unknown.

*Euchirella bella* Giesbrecht, 1888

(PLATE 9, FIGS. 1–13)

Pacific records: Vervoort, 1949; Wilson, 1950.

| Vessel: | Station | Occurrence |
|---|---|---|
| *Hugh M. Smith* | 153 | 2 females, 3.90, 4.18 mm.; 1 male, 3.33 mm. |
| Do | 31 | 2 females, 3.80 mm.; 1 male, 3.36 mm. |
| Do | 63 | 1 female, 3.80 mm. |
| *Stranger* | 34 | 1 female, 3.80 mm. |

Remarks: The species of female *Euchirella* are distinguished by the shape of the genital segment, number of setae on the endopod of the second antennae and the spination of the first basipodal segment of the fourth pair of feet. The males are identified by the structure of the fifth feet. The genital segment of *E. bella* is nearly symmetrical in dorsal view (figs. 1, 3) and is produced in ventral view (figs. 2, 4). The second segment of the endopod of the second antennae in the specimens examined has 5 setae on the outer and 5 setae on the inner lobe (fig. 5). Giesbrecht and Schmeil (1898) state that there are 6 and 5 setae on these respective lobes. The males in the present collections have 6 setae on the external lobe and 7 on the internal lobe, the 2 most internal ones being very small and slender. Vervoort (1949) indicated that there were 6 setae on each lobe. The number of spines on the first basipodal segment of the fourth feet is variable. Some specimens have 5 on each side and others have 4 on one side and 3 on the other (fig. 9). Scott (1909) and Sewell (1947) have also noted a variable number of spines on this segment.

Wilson (1950) has erroneously synonymized *E. amoena* with this species. See discussion of this under *E. amoena* below.

*Euchirella venusta* Giesbrecht, 1888

(PLATE 9, FIGS. 14–25)

Pacific records: Scott, 1909; Farran, 1929; Vervoort, 1949; Wilson, 1950; Tanaka, 1953; 1957b.

| Vessel: | Station | Occurrence |
|---|---|---|
| *Hugh M. Smith* | 63 | 4 females, 4.37–4.84 mm.; 1 male, 3.8 mm. |

Remarks: The female is identified by th knob-like protrusion from the left posteric margin of the genital segment (fig. 16); th presence of 4 setae on the inner lobe and setae on the external lobe of the endopod of th second antennae (fig. 18); and the two lon spines on the first basipodal segments of th fourth pair of feet. Sewell (1947) has recentl described the male, additional figures of whic are given herein (figs. 20–25). The second an tennae (fig. 23) have 6 setae on the outer lob and 7 setae on the inner lobe, 2 of which ar small. Sewell reported 6 setae on each lob The structure of the fifth feet agrees quite we with Sewell's figure of this appendage.

*Euchirella pulchra* (Lubbock, 1856)

(PLATE 10, FIGS. 1–4)

Pacific records: Esterly, 1905; Scott, 1909; Johnso 1942; Wilson, 1942; Davis, 1949; Vervoort, 194 Brodsky, 1950; Wilson, 1950; Tanaka, 1953; 1957b.

| Vessel: | Station | Occurrence |
|---|---|---|
| *Hugh M. Smith* | 63 | 1 female, 3.42 mm. |

Remarks: The genital segment is produce into a rounded swelling to the left (fig. 2). Th second segment of the endopod of the secon antennae has 6 setae on each lobe (fig. 3 This is the number reported also by Tanak (1957b), but Giesbrecht and Schmeil (1898 and Vervoort (1952) stated that the interna lobe has 5 setae. Possibly the very small, inne most seta on the internal lobe was overlooke An additional identification character is th presence of 2 spines on the first basipodal seg ment of the fourth pair of feet (fig. 4).

*Euchirella amoena* Giesbrecht, 1888

(PLATE 10, FIGS. 5–10)

Synonymy

*Euchirella amoena* Giesbrecht, 1888, Atti Acc. Linc Rend., Ser. 4, 4, sem. 2: 336.

*Euchirella brevis*, Sars, 1905. Bull. Mus. Oceanog Monaco, 26: 12.

*Euchirella bella* (partim), Wilson, 1950, U.S.N.M Bull. 100, 14: 218.

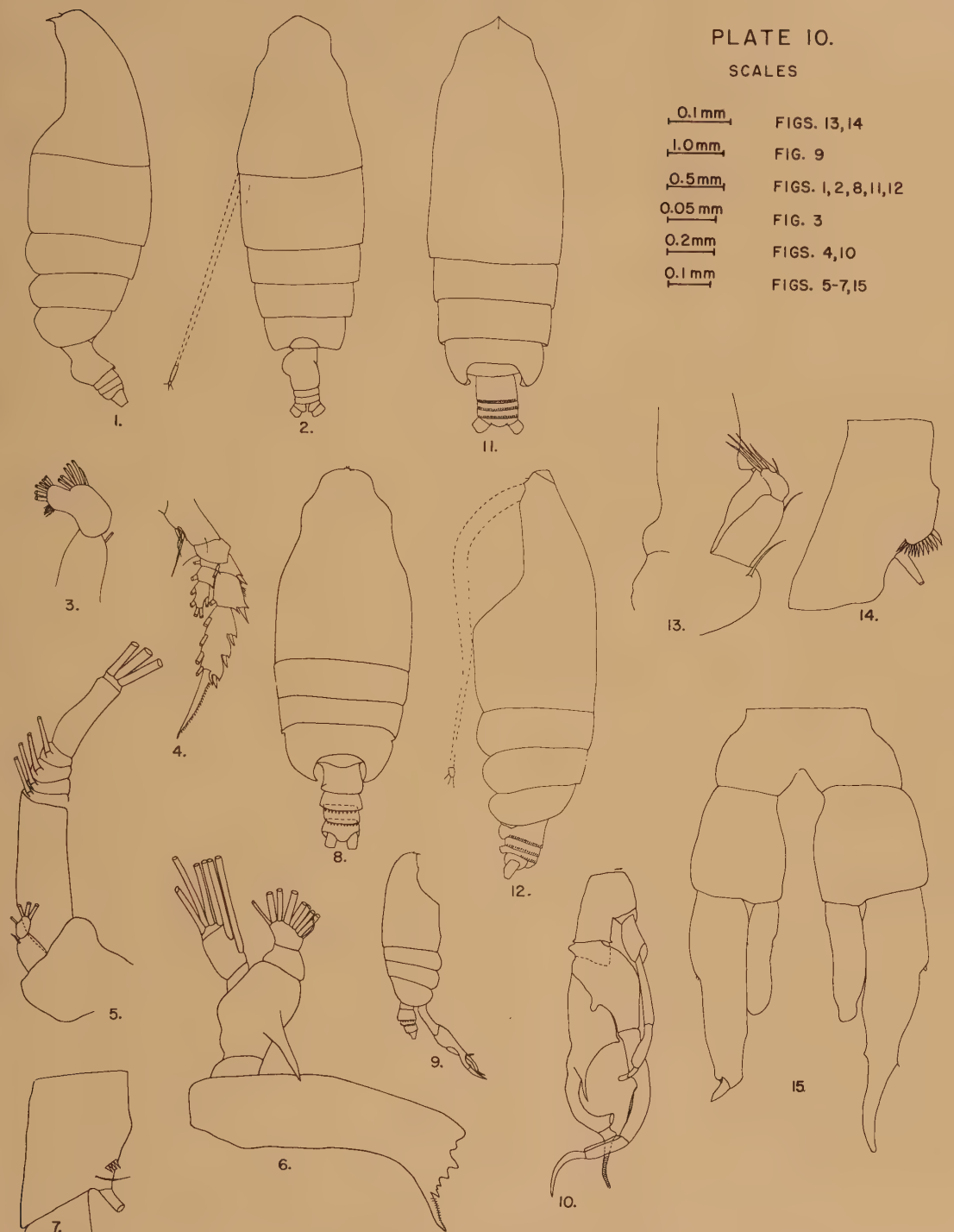


PLATE 10.—(1) *Euchirella pulchra*, female, lateral view; (2) dorsal view; (3) endopod of second antenna; (4) fourth foot; (5) *E. amoena*, female, second antenna; (6) mandible; (7) first basipodal segment of fourth foot; (8) male, dorsal view; (9) lateral view; (10) fifth pair of feet; (11) *E. curticauda*, female, dorsal view; (12) lateral view; (13) endopod of second antenna; (14) first basipodal segment of fourth foot; (15) *E. maxima*, stage V, male, fifth pair of feet.

Pacific records: Esterly, 1905; Scott, 1909; Farran, 1929; Mori, 1937; Wilson, 1942; Brodsky, 1950; Wilson, 1950; Tanaka, 1953; Chiba, Tsuruta, and Maéda, 1955; Nagaya et al., 1955; Chiba, 1956; Tanaka, 1957b; Yamazi, 1958a.

| Vessel: | Station | Occurrence |
|---|---|---|
| *Hugh M. Smith* | 132 | 1 male, 3.20 mm. |
| Do | 144 | 1 female, 3.70 mm. |
| Do | 153 | 2 females, 3.61, 3.70 mm.; 3 males, 3.33 mm. |
| Do | 178 | 1 female, 3.80 mm. |
| Do | 63 | 1 male, 3.33 mm. |

Remarks: Fleminger (1956) is no doubt correct in placing Sars' (1905) *brevis* (described from female) in synonymy with Giesbrecht's (1888) *amoena* (described from male). This synonymy is further substantiated by Mori's (1937) description of the female of *amoena*. Although Mori did not describe the fourth pair of feet, the total length, abdomen-cephalothorax ratio, length of the first antennae, length of the endopod of the second antennae and the number of setae on the distal segment of the endopod of the second antennae clearly establish that Mori's *E. amoena* and Sars' *E. brevis* are unispecific.

As Fleminger has stated, Wilson's synonymy of *E. amoena* under *E. bella* is an error. The male of *E. bella* was described by Sewell (1947) and Vervoort (1949); neither author was cited by Wilson. It should be noted, however, that Dr. Wilson's paper was published nine years after his death.

*Euchirella curticauda* Giesbrecht, 1888

(PLATE 10, FIGS. 11–14)

Pacific records: Esterly, 1906; Scott, 1909; Johnson, 1942; Mori, 1942; Wilson, 1942; Davis, 1949; Brodsky, 1950; Wilson, 1950; Anraku, 1952; Tanaka, 1953; 1957b.

| Vessel: | Station | Occurrence |
|---|---|---|
| *Orsom* | 10 | 2 females, 3.52, 3.62 mm. |

Remarks: This species is recognized by the presence of a crest, absence of a rostrum (fig. 12) and the presence of a comb of spines on the first basipodal segment of the fourth pair of feet (fig. 14).

*Euchirella maxima* Wolfenden, 1905

(PLATE 10, FIG. 15)

Pacific records: Scott, 1909; Wilson, 1950.

| Vessel: | Station | Occurrence |
|---|---|---|
| *Hugh M. Smith* | 29 | 1 female (stage V), 5.79 mm.; 1 male (stage V), 5.70 mm. |

Remarks: A male and female were obtained in the 500 m. collection made at the above station. Both sexes have a crest on the forehead. Sewell (1929) has described the stage V individuals of this species.

*Pseudochirella* sp.

| Vessel: | Station | Occurrence |
|---|---|---|
| *Hugh M. Smith* | 29 | 4 juveniles, 6.93–7.14 mm. |

Remarks: These large juvenile copepods could not be assigned to a species. They were obtained from the 500–meter plankton tow.

*Chirundina streetsi* Giesbrecht, 1895

(PLATE 11, FIGS. 1–4)

Pacific records: Esterly, 1906; Scott, 1909; Farran, 1929; Johnson, 1942; Brodsky, 1950; Wilson, 1950; Tanaka, 1953; 1957b.

| Vessel: | Station | Occurrence |
|---|---|---|
| *Horizon* | 32 | 1 female, 4.94 mm. |

Remarks: This species is distinguished from the following one by its large size, pronounced crest on forehead (fig. 1), and the presence of 2 spines on the first exopodal segment of the first feet (fig. 4).

*Chirundina indica* Sewell, 1929

(PLATE 11, FIGS. 5–20)

Pacific records: None.

| Vessel: | Station | Occurrence |
|---|---|---|
| *Hugh M. Smith* | 63 | 1 female, 4.66 mm. |

Remarks: I have compared in some detail (figs. 5–20) the present species with the descriptions of *C. indica* provided by Sewell (1929, 1947). On the basis of his description the latter species is distinguished from *C.*

PLATE 11.—(1) *Chirundina streetsi*, female, forehead, lateral view; (2) posterior part of thorax and abdomen, dorsal view; (3) abdomen, lateral view; (4) first foot; (5) *C. indica*, forehead, lateral view; (6) posterior part of thorax and abdomen, dorsal view; (7) posterior part of thorax and abdomen, ventral view; (8) posterior part of thorax and abdomen, lateral view; (9) second antenna; (10) mandible palpus; (11) gnathal lobe of mandible; (12) first maxilla; (13) terminal part of third inner lobe of first maxilla; (14) second maxilla; (15) first basipodal segment of maxilliped; (16) distal part of maxilliped; (17) first foot; (18) second pair of feet (one exopod and one endopod missing); (19) third foot; (20) fourth foot (distal part of exopod missing).

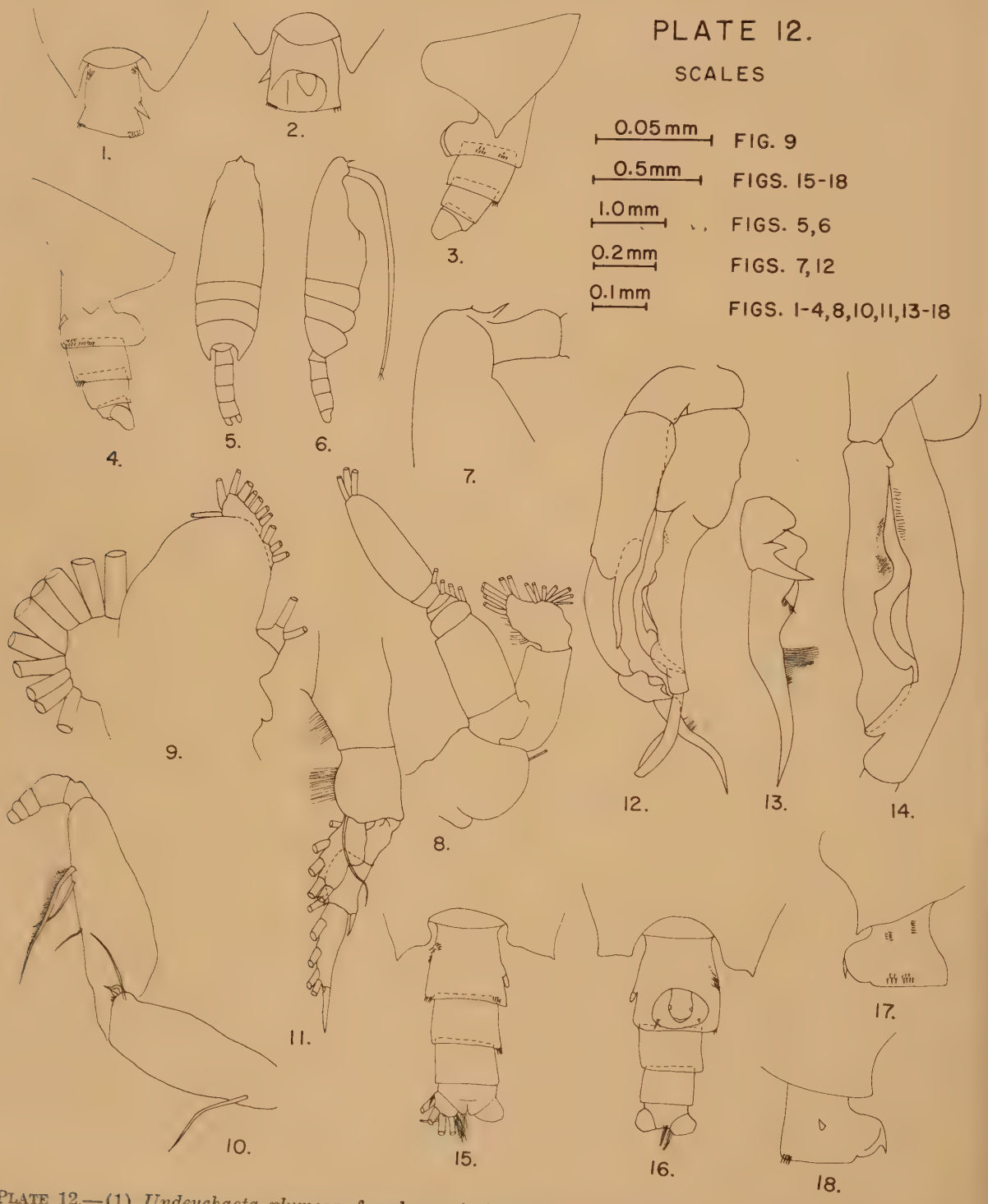


PLATE 12.—(1) *Undeuchaeta plumosa*, female, genital segment, dorsal view; (2) ventral view; (3) posterior part of thorax and abdomen, left side; (4) posterior part of thorax and abdomen, right side; (5) male, dorsal view; (6) lateral view; (7) forehead, lateral view; (8) second antenna; (9) first maxilla (part); (10) maxilliped (setae on distal part omitted); (11) first foot; (12) fifth pair of feet; (13) terminal part of left fifth foot; (14) right fifth foot (part); (15) *U. intermedia*, female, dorsal view; (16) abdomen, ventral view; (17) genital segment, left side; (18) genital segment, right side.

*streetsi* by its low crest, the smoothly rounded posterior thoracic margins and the presence of but 1 external spine on the first exopodal segment of the first feet. Except for the posterior thoracic margins, which have 1 small projection (figs. 7–9), my specimen agrees with Sewell's *indica*. In details of the mouth parts, two minor differences were noted. Sewell's specimens have 6 setae on the outer lobe of the second antenna, while the present specimen has 7 (fig. 10); the exopod of the mandible has 9 setae (Sewell probably referred to the distal segment); the present specimen has 10, one of which is extremely small (fig. 11).

The projections on the posterior thoracic margins may be a variable character as Vervoort (1957) has observed in several species of a related genus, *Undeuchaeta*. It seems best therefore to refer the present species to *C. indica*.

*Undeuchaeta plumosa* (Lubbock, 1856)

(PLATE 12, FIGS. 1–14)

Pacific records: Vervoort, 1957. Also, Brodsky, 1950; Heinrich, 1957b; Tanaka, 1957b.

| Vessel: | Station | Occurrence |
|---|---|---|
| *Hugh M. Smith* | 63 | 1 male, 3.52 mm. |
| *Horizon* | 32 | 1 female, 3.47 mm. |
| *Satsuma* | 32 | 1 female, 3.41 mm. |

Remarks: The female is distinguished by the presence of a spine on the right side of the genital segment (figs. 1, 2) near the dorsal surface, and the male by the structure of the fifth feet (figs. 12–14).

*Undeuchaeta intermedia* A. Scott, 1909

(PLATE 12, FIGS. 15–18)

Pacific records: Vervoort, 1957. Also, Johnson, 1942; Brodsky, 1950 (as *U. bispinosa*)

| Vessel: | Station | Occurrence |
|---|---|---|
| *Hugh M. Smith* | 63 | 4 females, 3.99–4.28 mm. |
| *Horizon* | 32 | 3 females, 3.99–4.08 mm. |

Remarks: The large ventral spine-like protrusion of the genital segment in the female (figs. 17, 18) distinguishes this species from the preceding one.

Family EUCHAETIDAE

*Euchaeta marina* (Prestandrea, 1833)

(PLATE 13, FIG. 1)

Pacific records: Scott, 1909; Marukawa, 1921; Yamada, 1933b; Mori, 1937; Dakin and Colefax, 1940; Mori, 1942; Wilson, 1942; Brodsky, 1950; Motoda, Iizuka, and Anraku, 1950; Wilson, 1950; Anraku, 1952; Honjo, 1952; Nakai, 1952; Anraku, 1953; Chiba, 1953b; Tanaka, 1953; Anraku, 1954b; Tsuruta and Chiba, 1954b; Chiba, Tsuruta, and Maéda, 1955; Motoda and Anraku, 1955; Nagaya et al., 1955; Rose, 1955; Chiba, 1956; Heinrich, 1957b; Honjo et al., 1957; Gilmartin, 1958; Heinrich, 1958a; Tanaka, 1958; Yamazi, 1958a; Lindberg, 1959.

| Vessel: | Station | Occurrence |
|---|---|---|
| *Hugh M. Smith* | 132 | 1 male, 3.12 mm. |
| Do | 144 | 1 female, 3.61 mm. |
| Do | 153 | 2 females, 3.32, 3.42 mm. |
| Do | 178 | 1 female, 3.06 mm. |
| Do | 30 | 3 females, 2.96–3.06 mm.; 1 male, 2.99 mm. |
| Do | 31 | present. |
| Do | 63 | 4 females, 3.40–3.60 mm.; 1 male, 3.37 mm. |
| *Stranger* | 34 | 4 females, 3.13–3.26 mm.; 5 males, 3.06–3.23 mm. |
| *Orsom* | 10 | 3 females, 3.13–3.23 mm. |
| *Horizon* | 32 | 2 females, 3.13, 3.23 mm. |

Remarks: This is probably the most widespread species in the genus. It occurred in ten of the present samples and in two (*Smith* 153 and 30), it comprised a fairly significant percentage of the total number of copepods.

*Euchaeta wolfendeni* A. Scott, 1909

(PLATE 13, FIGS. 2–9)

Pacific records: Farran, 1936; Mori, 1937; Wilson, 1950; Honjo, 1952; Tanaka, 1953; Tsuruta and Chiba, 1954b; Chiba, Tsuruta, and Maéda, 1955; Nagaya et

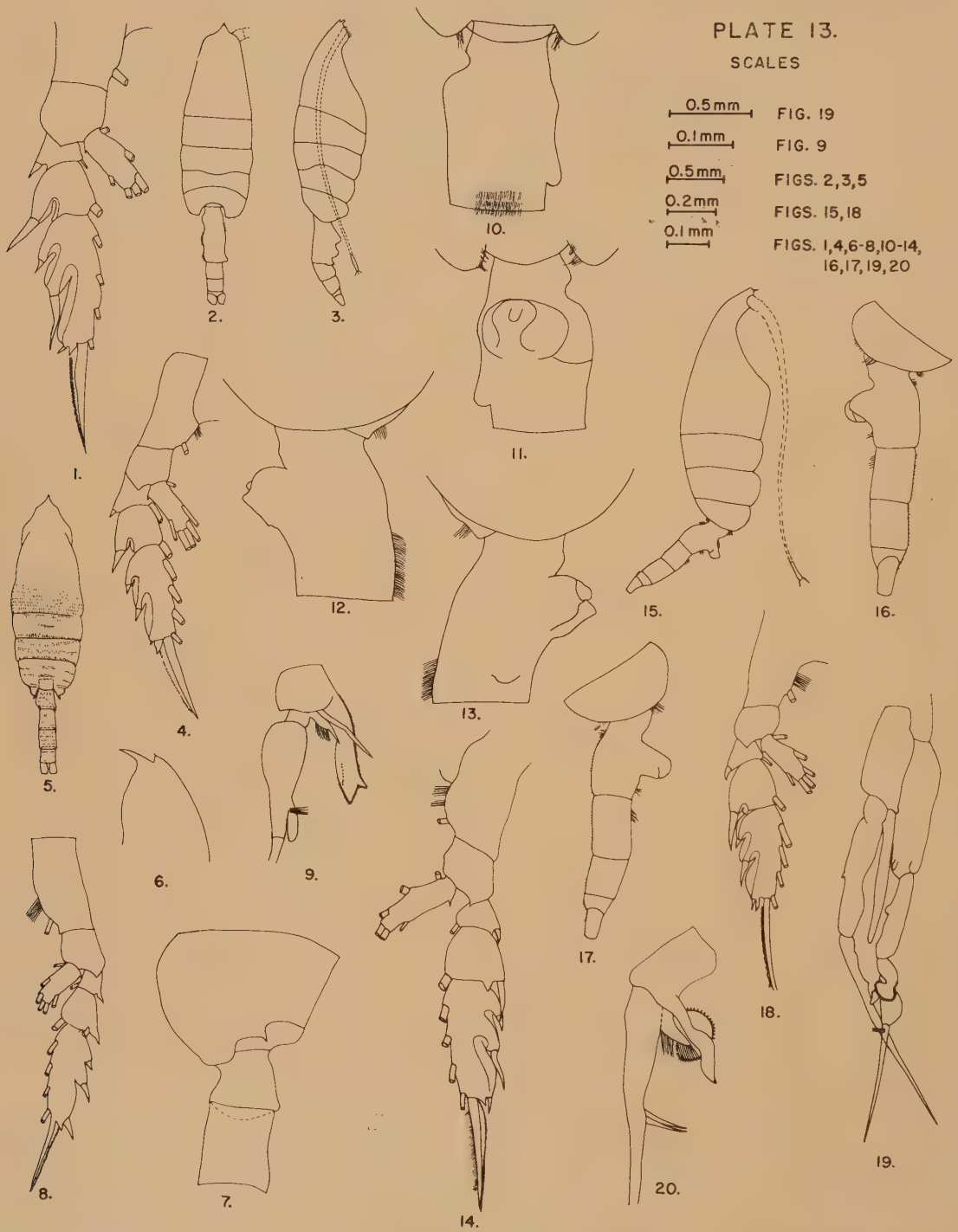


PLATE 13.—(1) *Euchaeta marina*, female, second foot; (2) *E. wolfendeni*, female, dorsal view; (3) lateral view; (4) second foot; (5) male, dorsal view; (6) forehead, lateral view; (7) posterior part of thorax and first two abdominal segments, lateral view; (8) second foot; (9) terminal part of left fifth foot; (10) *E. media*, female, genital segment, dorsal view; (11) genital segment, ventral view; (12) genital segment, left side; (13) genital segment, right side; (14) second foot; (15) *E. tenuis*, female, lateral view; (16) posterior part of thorax and abdomen, left side; (17) posterior part of thorax and abdomen, right side; (18) second foot; (19) male, fifth pair of feet; (20) terminal part of left fifth foot.

al., 1955; Chiba, 1956; Honjo et al., 1957; Tanaka, 1958; Yamazi, 1958a.

| Vessel: | Station | Occurrence |
|---|---|---|
| *Hugh M. Smith* | 132 | 1 female, 2.50 mm. |
| Do | 63 | 1 female, 2.52 mm. |
| *Stranger* | 34 | 3 females, 2.24–2.38 mm.; 2 males, 2.21, 2.35 mm. |
| *Horizon* | 32 | 1 female, 2.55 mm.; 3 males, 2.31–2.44 mm. |
| *Satsuma* | 32 | 2 females, 2.38, 2.40 mm.; 1 male, 2.31 mm. |

Remarks: The female is distinguished by the long genital segment, the right posterior margin of which is produced into a rounded knob (fig. 2). The relative lengths of the outer-edge spines on the second and third exopodal segments of the second feet (fig. 4) are also diagnostic (cf. *E. marina*, plate 13, fig. 1). The male is identified by the structure of the terminal part of the left fifth foot (fig. 9).

### *Euchaeta media* Giesbrecht, 1888

(PLATE 13, FIGS. 10–14)

Pacific records: Vervoort, 1957. Also, Johnson, 1942; Brodsky, 1950; Tsuruta and Chiba, 1954b; Chiba, Tsuruta, and Maéda, 1955; Nagaya et al., 1955; Heinrich, 1957b; Honjo et al., 1957; Tanaka, 1958.

| Vessel: | Station | Occurrence |
|---|---|---|
| *Hugh M. Smith* | 63 | 1 female, 3.52 mm. |

Remarks: The female of *E. media* is recognized by the characteristic swelling on the left side and the knob-like protrusion on the right side of the genital segment (figs. 10, 11). The middle spine on the outer edge of the third exopodal segment of the second pair of feet is elongate and the spine on the second exopodal segment reaches beyond the base of the proximal spine on the third segment (fig. 14).

### *Euchaeta tenuis* Esterly, 1906

(PLATE 13, FIGS. 15–20)

Pacific records: Esterly, 1906; Scott, 1909; Brodsky, 1950. As *E. solida*, Esterly, 1911.

| Vessel: | Station | Occurrence |
|---|---|---|
| *Hugh M. Smith* | 29 | 4 females, 5.60–5.98 mm.; 3 males, 5.03–5.22 mm. |
| Do | 63 | 1 female, 5.13 mm.; 1 male, 4.75 mm. |
| Do | 32 | present. |

Remarks: The large and asymmetrical ventral protrusions (figs. 16, 17) of the female genital segment will identify this species. The outer-edge spines of the second pair of feet (fig. 18) are also diagnostic. In the male the structure of the second segment of the left fifth foot (figs. 19, 20) is characteristic. It is dilated and coarsely serrate.

### *Euchaeta concinna* Dana, 1849

(PLATE 14, FIGS. 1–13)

Synonymy:

*Euchaeta consimilis* Farran, 1936, Great Barrier Reef Exped. 1928–29. Sci. Rept. 5(3): 90.

Pacific records: Scott, 1909; Farran, 1936; Mori, 1937; Dakin and Colefax, 1940; Wilson, 1950; Tanaka, 1953; Rose, 1955; Honjo et al., 1957; Heinrich, 1958b; Tanaka, 1958. As *E. consimilis;* Farran, 1936; Rose, 1955.

| Vessel: | Station | Occurrence |
|---|---|---|
| *Satsuma* | 32 | 3 females, 2.52–2.55 mm.; 1 male, 2.24 mm. |

Remarks: Farran (1936) described *E. consimilis* from 4 female specimens collected near the Great Barrier Reef. He also found *E. concinna* in his collections, but this species was observed only inside the reef where it was one of the most characteristic of the copepods. According to Farran, *consimilis* differs, morphologically, from *concinna* in the form of the protrusion on the right side of the genital segment in the female (see Farran's fig. 6) and in size. As Farran pointed out, Sewell (1929) observed "a considerable degree of variation" in the form of the genital protrusion in *concinna* collected in the Indian Ocean. The latter author suggested that this variation may be correlated with egg laying which causes the protrusion to increase in size.

The size of specimens, as recorded in the literature is also variable.

| Source: | Female | Male |
|---|---|---|
| Mori, 1937 (Japan) | 3.0 mm. | |
| Tanaka, 1958 (Japan) | 2.87–3.25 mm. | |

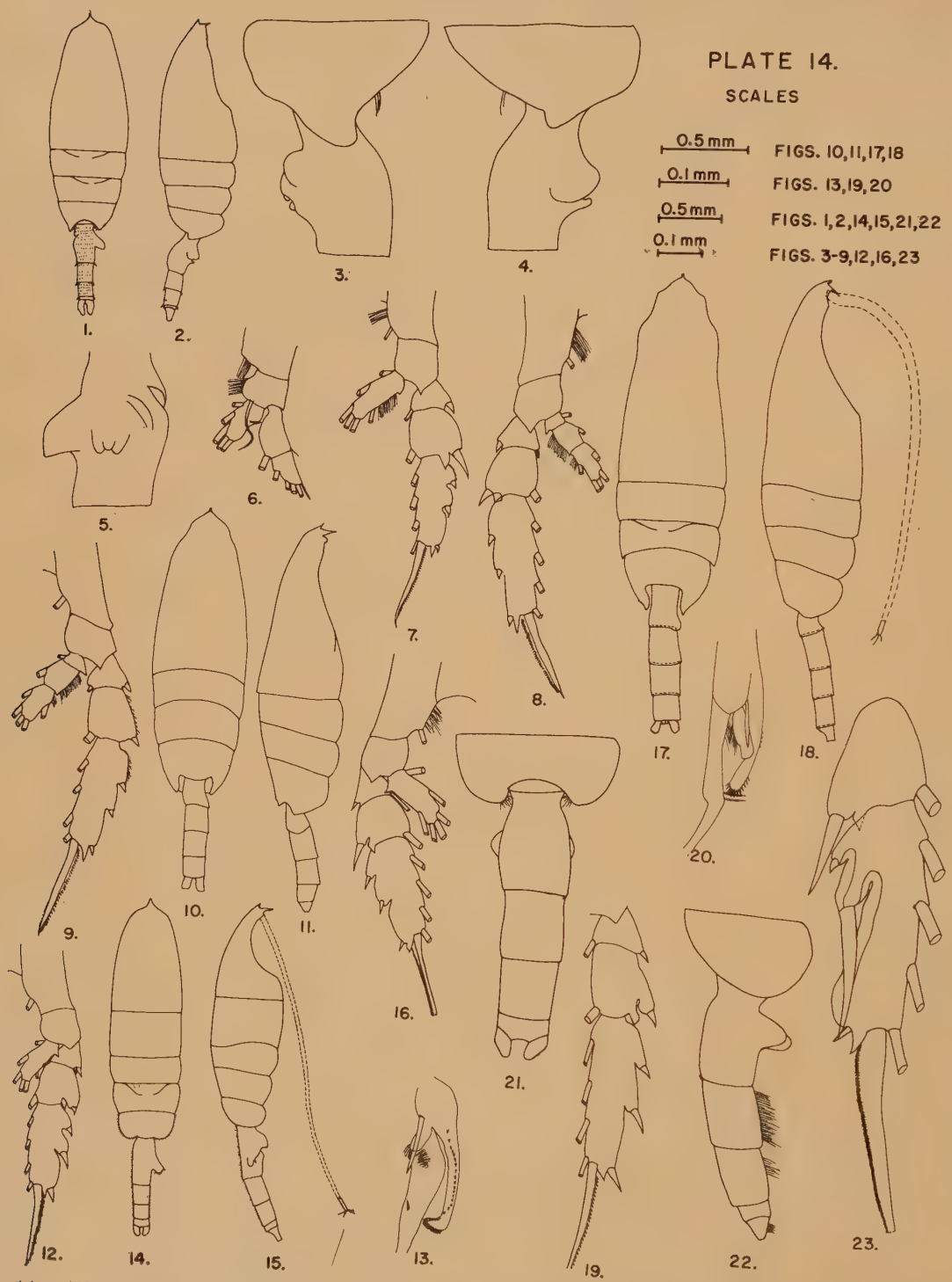


PLATE 14.—(1) *Euchaeta concinna*, female, dorsal view; (2) lateral view; (3) posterior part of thorax and genital segment, left side; (4) posterior part of thorax and genital segment, right side; (5) genital segment, ventral side; (6) first foot; (7) second foot; (8) third foot; (9) fourth foot; (10) male, dorsal view; (11) lateral view; (12) second foot; (13) terminal part of left fifth foot; (14) *E. longicornis*, female, dorsal view; (15) lateral view; (16) second foot; (17) male, dorsal view; (18) lateral view; (19) exopod of second foot; (20) terminal part of left fifth foot; (21) *E. spinosa*, female, posterior part of thorax and abdomen, dorsal view; (22) lateral view; (23) second and third segments of exopod of second foot.

| Vessel: | Station | Occurrence |
|---|---|---|
| Giesbrecht and Schmeil, 1898 (tropical Pacific) | 3.3 mm. | 2.75 mm. |
| Heinrich, 1958b (tropical Pacific) | 2.5 mm. | ---------- |
| Farran, 1936 (inside Barrier Reef) | 3.25–3.40 mm. | 2.54–2.76 mm. |
| Farran, 1936 (outside Barrier Reef) | 2.36–2.67 mm. | ---------- |
| Dakin and Colefax, 1940 (Australia) | 3.75 mm. | 2.6 mm. |
| Sewell, 1929 (Indian Ocean) | 2.5–3.5 mm. | 2.4–3.0 mm. |
| Wolfenden, 1905 (Indian Ocean) | 2.75–3.0 mm. | ---------- |

In view of the wide size range in both sexes and the variable nature of the genital segment in the female, it seems best to consider *E. consimilis* as a synonym of *E. concinna.*

*Euchaeta longicornis* Giesbrecht, 1888

(Plate 14, figs. 14–20)

Pacific records: Scott, 1909; Farran, 1929; 1936; Mori, 1937; Wilson, 1950; Honjo, 1952; Nakai, 1952; Tanaka, 1953; Anraku, 1954b; Chiba, Tsuruta, and Maéda, 1955; Nagaya et al., 1955; Honjo et al., 1957; Tanaka, 1958.

| Vessel: | Station | Occurrence |
|---|---|---|
| *Hugh M. Smith* | 94 | 3 females, 2.88 mm. |
| Do | 132 | 8 females, 2.65–2.92 mm.; 1 male, 2.65 mm. |

Remarks: The female genital segment has a large protrusion on the right side from which arises a smaller spine-like process.

Wilson (1950) described the male sex of this species. I have compared my single male specimen (except the body, which was destroyed in dissection) to one identified by G. O. Sars and loaned to me by the U.S. National Museum. The two are unispecific. In the Museum specimen a small spine is present on the superior-lateral margins of the fifth thoracic segment as is also found on the male of *E. wolfendeni* (see plate 13, fig. 7). I probably overlooked these spines in my specimen and therefore they are not shown in the figure given of the male (fig. 18).

*Euchaeta spinosa* Giesbrecht, 1892

(Plate 14, figs. 21–23)

Pacific records: Esterly, 1905; Johnson, 1942; Brodsky, 1950; Wilson, 1950; Tanaka, 1953; 1958. As male of *Undeuchaeta major;* Esterly, 1905.

| Vessel: | Station | Occurrence |
|---|---|---|
| *Hugh M. Smith* | 29 | 1 female, 6.94 mm. |

Remarks: The ventral projections of the genital segment (fig. 22) are visible in dorsal view. The middle spine on the outer margin of the third exopodal segment of the second feet is greatly elongate, and the spine on the second exopodal segment surpasses the tip of the first spine on the third segment (fig. 23).

Family PHAENNIDAE

*Phaenna spinifera* Claus, 1863

(Plate 15, fig. 1)

Pacific records: Scott, 1909; Farran, 1929; Mori, 1937; Wilson, 1942; 1950; Tanaka, 1953; Anraku, 1954b; 1954c; Tsuruta and Chiba, 1954b; Chiba, Tsuruta, and Maéda, 1955; Motoda and Anraku, 1955; Nagaya et al., 1955; Chiba, 1956; Honjo et al., 1957; Yamazi, 1958a. As *Onchocalanus nudipes;* Wilson, 1942.

| Vessel: | Station | Occurrence |
|---|---|---|
| *Hugh M. Smith* | 94 | present. |
| Do | 132 | 3 females, 1.87–1.90 mm. |
| Do | 31 | 1 female, 1.60 mm. |
| Do | 63 | present. |
| *Orsom* | 10 | 1 female, 1.87 mm. |
| *Horizon* | 32 | present. |

Remarks: The globular thorax, small abdomen, and lack of fifth feet (in the female) make this species easily recognized. Vervoort (1950) placed Wilson's *Onchocalanus nudipes* in synonymy with *Phaenna spinifera.*

*Xanthocalanus dilatus* n. sp.

(Plate 15, figs. 2–11)

| Vessel: | Station | Occurrence |
|---|---|---|
| *Hugh M. Smith* | 144 | 2 females, 1.56, 1.60 mm. |

Description: The head and first thoracic segment and fourth and fifth thoracic segments are separate (figs. 2, 3). The posterior lateral margins of the first thoracic segment are dis-

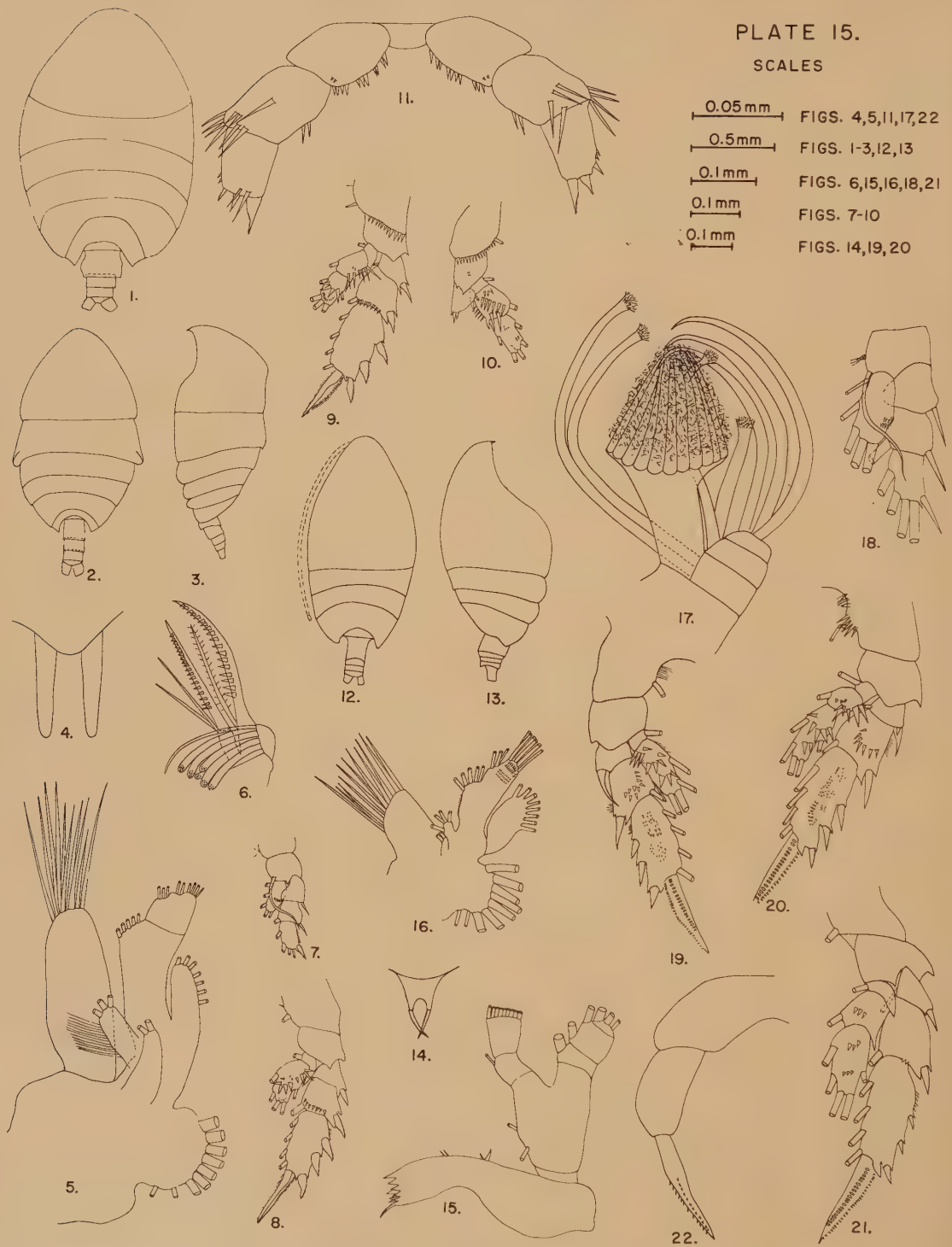


PLATE 15.—(1) *Phaenna spinifera*, female, dorsal view; (2) *Xanthocalanus dilatus* n.sp., female, dorsal view (3) lateral view; (4) rostrum; (5) first maxilla, (6) terminal part of second maxilla; (7) first foot; (8) second foot; (9) third foot; (10) fourth foot (distal two segments of exopod missing); (11) fifth pair of feet (figs. 2–4 and 11 of holotype, figs. 7–10 of paratype); (12) *Amallophora smithae* n. sp., female, dorsal view; (13) lateral view; (14) rostrum; (15) mandible; (16) first maxilla; (17) terminal part of second maxilla; (18) first foot (19) second foot; (20) third foot; (21) fourth foot; (22) fifth foot (figs. 12–22 of holotype).

hded and there is a distinct dilation on the rsal surface of the head. The rostrum is raight and club-like (fig. 4).

The first antennae of both specimens are oken off near the proximal end. Although mewhat mutilated, the second antennae ap- ar to have 1 seta on the first segment of the dopod. The second segment of the endopod s 14 setae on the distal margin (8 on the in- r lobe and 6 on the outer lobe). The exopod s a total of 6 setae but some may be missing om the various segments.

The mandible has 3 setae on the basipod, 11 tae on the endopod and 6 on the exopod.

The first maxilla (fig. 5) has the following mber of setae: 9 on the external lobe, 7 on e exopod, 9 on the endopod, 5 on the second sal segment, 2 on the second internal lobe and on the third internal lobe.

The terminal part of the second maxilla (fig. has 6 sensory organs and 1 worm-like ap- ndage.

The exopods of the first 4 pairs of feet are segmented (figs. 7–10), although the second d third exopodal segments of the fourth pair e broken off. The endopod of the first foot nsists of 1 segment, of the second foot of 2 gments and of the third and fourth feet of 3 gments. The endopodal segments of the sec- d and third feet have numerous spines aris- g from their posterior surfaces. A row of ines is present at the junction of the first and cond basipodal segments, on the posterior de, of the third and fourth feet. The fifth ot (fig. 11) consists of 3 segments, all of hich are furnished with either marginal or rface spines.

Remarks: This species differs from other de- ribed *Xanthocalanus* in (1) the dilations of he dorsal surface of the head and lateral mar- ins of the first thoracic segment, (2) the ines on the basipodal segments of the third nd fourth feet, and (3) the details of the fifth air of feet. The fifth pair of feet closely re- emble those of *X. agilis* Giesbrecht but *agilis* cks the characteristic dilations of the head nd first thoracic segment of the present spe- es. In addition, *X. agilis* is a larger species 2.40 mm.). The presence of spines on the asipodal segments may also be found in other species of *Xanthocalanus*. Figures of these segments are available for only a few species.

The name proposed for this species is derived from the Latin word "dilato" and refers to the characteristic protrusions on the head and first thoracic segment. The holotype (U.S.N.M. No. 104, 420) and 1 paratype (No. 104, 421) have been deposited in the U.S. National Museum.

*Amallophora smithae* n. sp.

(PLATE 15, FIGS. 12–22)

| Vessel: | Station | Occurrence |
|---|---|---|
| *Hugh M. Smith* | 144 | 1 female, 1.40 mm. |

Description: The head and first thoracic segments and the fourth and fifth thoracic segments are fused (fig. 12). In lateral view the posterior margin of the cephalothorax has a small indentation (fig. 13).

The first antennae are short and do not reach the end of the cephalothorax. Each antenna consists of 23 segments.

The endopod of the second antenna is slightly less than three-fourths the length of the exopod. Endopodal segment 1 has 2 setae. Segment 2 has 8 setae on the inner lobe and 7 setae on the outer lobe. The exopod has 8 setae all of which are densely plumose.

The basal segment of the mandibular palpus has 2 setae (fig. 15). There are 9 setae on the distal segment of the endopod and 1 seta on the proximal segment. The exopod has a total of 6 setae.

The first maxilla (fig. 16) has the following number of setae: 11 on the first inner lobe, 2 on the second inner lobe, 4 on the third inner lobe, 5 on the second basal segment, 9 on the endopod, 8 on the exopod and 9 on the external lobe. Two groups of small spines are present on the surface of the endopod.

The terminal part of the second maxilla (fig. 17) has 1 enlarged sensory organ, 4 smaller sensory organs and 3 worm-like appendages.

The first and second basal segments of the maxilliped have 7 and 5 setae, respectively. The 5 endopodal segments have the following number of setae: 4, 4, 3, 3 (plus 1 external seta), and 4.

The first pair of feet have 3-segmented exopods and 1-segmented endopods (fig. 18). The

second pair of feet have exopods composed of 3 segments and endopods of 2 segments while the succeeding 2 pairs of feet each have 3-segmented exopods and endopods (figs. 19–21). The terminal spine of the second, third, and fourth pair of feet is characterized by an outer serrate margin and an inner row of small perforations. The endopods of the second and third feet have large spines arising from their surfaces. Numerous smaller spines are present on the 2 distal exopodal segments of the second and third feet. The fourth feet have a reduced number of spines.

The fifth feet (fig. 22) are small and consist of 2 segments. There is a stout and finely toothed spine arising from the distal segment.

Remarks: This species is closely related to *A. vorax* (Esterly, 1911). It differs from Esterly's species in the segmentation of the cephalothorax, cephalothorax-abdomen ratio, and the structure of the fifth feet. The fourth and fifth thoracic segments are separate in *A. vorax* but fused in *A. smithae*. Davis (1949) also reported that these segments in his specimen of *A. vorax* were fused. The cephalothorax is 6½ times longer than the abdomen in *A. vora* according to Esterly; in the present species is approximately 4 times the length of the ab domen. Davis stated that the abdomen of h specimen was longer than that reported b Esterly. In *A. vorax* there are two spines o the distal segment of the fifth feet. In *A smithae* there is one robust spine.

Vervoort (1957) has discussed the genu *Amallophora* and pointed out differences be tween it and the genus *Xanthocalanus*. Th structures of the maxillae and fifth feet appea to exclude the present species from the genu *Xanthocalanus* although the articulated rostra filaments are unlike those found in *Amallo phora*. If Brodsky (1950) is correct in assign ing Esterly's species (described as *Scolecithri vorax*) to the genus *Amallothrix* then perhap the present species should also be placed in thi genus. Until the *Xanthocalanus–Amallothrix Amallophora* complex is revised, I am referrin the present species to the genus *Amallophora*

The species is named for the research vesse *Hugh M. Smith*. The holotype is deposited i the U.S. National Museum (No. 104, 422).

## Family SCOLECITHRICIDAE

### *Scolecithrix danae* (Lubbock, 1856)

Pacific records: Esterly, 1905; Scott, 1909; Farran, 1929; Yamada, 1933; Farran, 1936; Mori, 1937; Dakin and Colefax, 1940; Johnson, 1942; Mori, 1942; Wilson, 1942; 1950; Anraku, 1952; Honjo, 1952; Nakai, 1952; Tanaka, 1953; Anraku, 1954b; Johnson, 1954; Tsuruta and Chiba, 1954b; Chiba, Tsuruta, and Maéda, 1955; Hida and King, 1955; Motoda and Anraku, 1955; Nagaya et al., 1955; Chiba, 1956; Honjo et al., 1957; Heinrich, 1958a; Yamazi, 1958a.

| Vessel: | Station | Occurrence |
|---|---|---|
| *Hugh M. Smith* | 132 | present. |
| Do | 144 | present. |
| Do | 153 | present. |
| Do | 178 | present. |
| Do | 30 | present. |
| Do | 31 | 3 females, 2.04–2.14 mm. |
| Do | 29 | 3 females, 2.01–2.04 mm. |
| Do | 63 | 4 females, 2.04–2.14; 3 males, 2.07–2.21 mm. |
| *Stranger* | 34 | 2 females, 2.00, 2.04 mm. |
| *Orsom* | 10 | 2 females, 2.01, 2.11 1 male, 1.97 mm |
| *Horizon* | 32 | 3 females, 2.04; 2 males, 2.04, 2.11 mm. |
| *Satsuma* | 32 | 2 females, 1.90, 2.00 mm. |

Remarks: The posteriorly directed ventra protrusion on the female genital segment an the structure of the fifth feet of the male serv to identify this species. Figures of both thes characters are given in Rose, 1933.

### *Scolecithrix bradyi* Giesbrecht, 1888

(PLATE 16, FIGS. 1–5)

Pacific records: Esterly, 1905; Farran, 1929; 193 As *Scolecithricella bradyi;* Scott, 1909; Mori, 1937 1942; Wilson, 1942; 1950; Honjo, 1952; Tanaka, 1953 Chiba, Tsuruta, and Maéda, 1955; Motoda and An raku, 1955; Nagaya et al., 1955; Chiba, 1956; Honj et al., 1957.

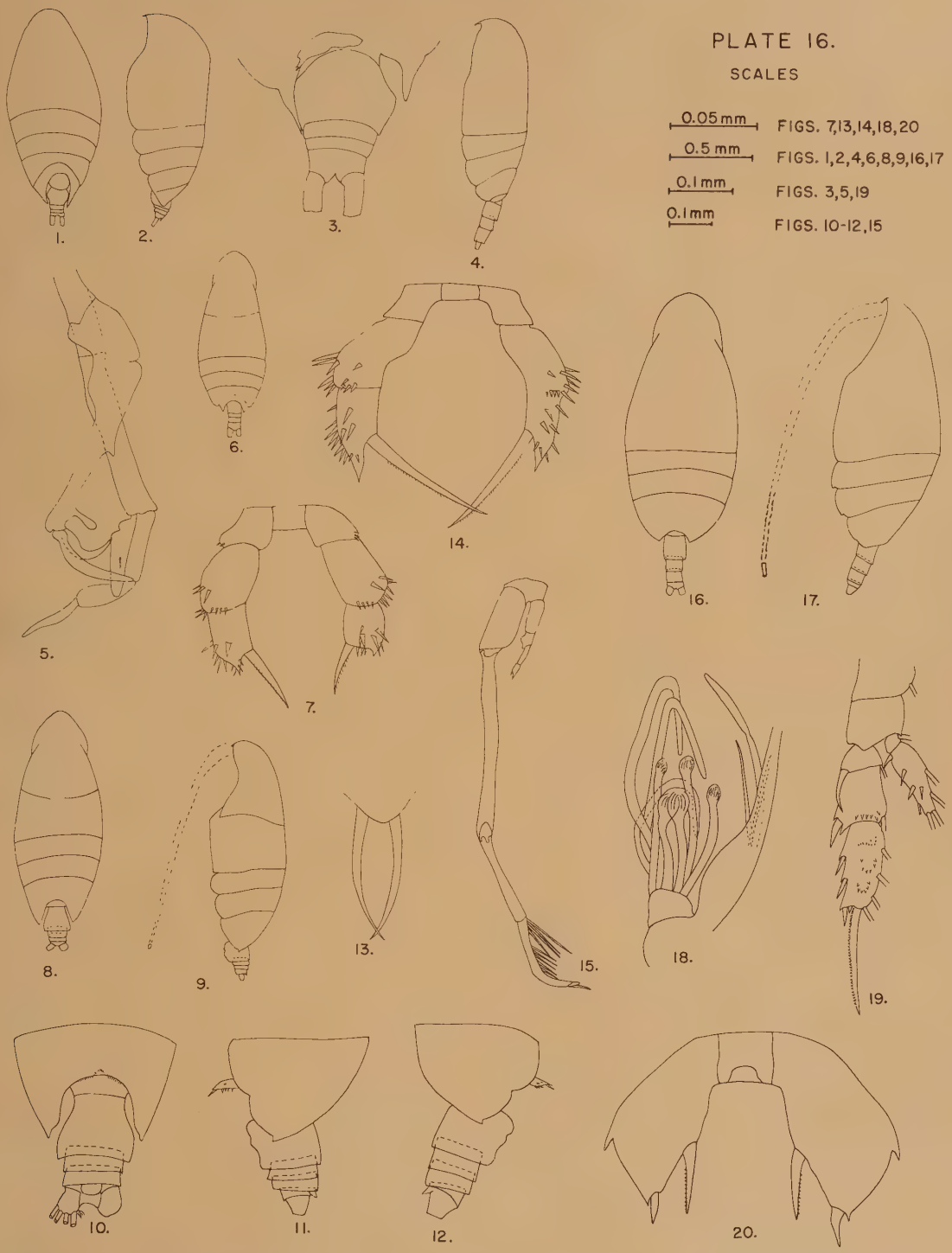


PLATE 16.—(1) *Scolecithrix bradyi*, female, dorsal view; (2) lateral view; (3) posterior part of thorax and ɔdomen, ventral view; (4) male, lateral view; (5) fifth pair of feet; (6) *Scolecithricella ctenopus*, female, juvenile, ɔrsal view; (7) fifth pair of feet; (8) adult, dorsal view; (9) lateral view; (10) posterior part of thorax and ɔdomen, dorsal view; (11) left side; (12) right side; (13) rostrum; (14) fifth pair of feet; (15) male, fifth pair feet; (16) *S. abyssalis*, female, dorsal view; (17) lateral view; (18) terminal part of second maxilla; (19) sec-d foot; (20) fifth pair of feet.

| Vessel: | Station | Occurrence |
|---|---|---|
| *Hugh M. Smith* | 94 | 11 females, 1.36–1.41; 2 males, 1.51, 1.56 mm. |
| Do | 132 | 4 females, 1.33–1.36 mm. |
| Do | 144 | present. |
| Do | 178 | present. |
| Do | 31 | present. |

Remarks: The asymmetrical posterior thoracic margins, the right one of which extends beyond the genital segment (fig. 1), serve to identify the female of this species. The male is recognized by the structure of the fifth feet (fig. 5).

*Scolecithricella ctenopus* (Giesbrecht, 1888)

(PLATE 16, FIGS. 6–15)

Synonymy:

*Scolecithrix ctenopus* Giesbrecht, 1888, Atti Acc. Lincei Rend., ser. 4, 4 sem. 2: 338.

*Scolecithricella ctenopus* Sewell, 1929, Mem. Ind. Mus., 10: 212.

*Scolecithrix longicornis* T. Scott, 1894, Trans. Linn. Soc., Zool., 6: 50.

*Scolecithricella spinipedata* Mori, 1937, The pelagic Copepoda from the neighbouring waters of Japan, p. 53.

Pacific records: Scott, 1909; Farran, 1936; Tanaka, 1953.

| Vessel: | Station | Occurrence |
|---|---|---|
| *Hugh M. Smith* | 94 | 1 juvenile female, 1.28 mm. |
| Do | 178 | 2 females, 1.49, 1.53; 1 male, 1.54 mm. |
| *Stranger* | 34 | 1 female, 1.46; 1 male, 1.46 mm. |
| *Orsom* | 10 | 1 female, 1.48 mm. |

Remarks: Farran (1936) found two females which differed in size, segmentation of thorax and structure of fifth feet. He also reviewed the records and descriptions of *S. longicornis* (Scott, 1894) and considered it a synonym of *S. ctenopus*.

The present female specimens also fall into two size groups, the smaller of which is very similar to Farran's small specimen. The head and thorax in this form are separated by a fine line (in Farran's specimen they were fused) and a faint line is also seen to separate the fourth and fifth thoracic segments (fig. 6). Although the fifth feet are fairly well differentiated, the genital segment is undeveloped in this small specimen. In the larger form (figs. 8–14) the head and first thoracic segment are incompletely fused and the fourth and fifth thoracic segments are completely fused. The genital segment is well developed as are the fifth feet.

Although it is slightly larger, Mori's *S. spinipedata,* is, in my opinion, a synonym of *S. ctenopus.*

*Scolecithricella abyssalis* (Giesbrecht, 1888)

(PLATE 16, FIGS. 16–20)

Pacific records: Scott, 1909; Mori, 1937; Tanaka, 1937; Wilson, 1942; 1950; Anraku, 1952; Tanaka, 1953; Brodsky, 1955; Chiba, Tsuruta, and Maéda, 1955; Nagaya et al., 1955; Chiba, 1956.

| Vessel: | Station | Occurrence |
|---|---|---|
| *Hugh M. Smith* | 94 | 6 females, 1.87–1.90 mm. |
| Do | 144 | 1 female, 1.74 mm. |
| Do | 29 | 1 female, 2.21 mm. |
| Do | 63 | 1 female, 1.87 mm. |

Remarks: Some variation was noted in the structure of the fifth feet of this species. Several specimens did not have the small spine-like protrusion near the terminal spine as shown in the fifth feet figured here (fig. 20).

*Scolecithricella vittata* (Giesbrecht, 1892)

(PLATE 17, FIGS. 1–8)

Pacific records: Farran, 1936; Wilson, 1950; Tanaka, 1953.

| Vessel: | Station | Occurrence |
|---|---|---|
| *Hugh M. Smith* | 94 | 2 females, 1.66 mm. |

Remarks: As in the preceding species, variation was noted in the fifth feet of this species. The terminal seta in one specimen was approximately twice the length of the proximal one (fig. 8) while in the other specimen it was somewhat shorter (fig. 4).

*Scolecithricella tenuiserrata* (Giesbrecht, 1892)

(PLATE 17, FIGS. 9–21; PLATE 18, FIG. 1)

Pacific records: Farran, 1936; Tanaka, 1953.

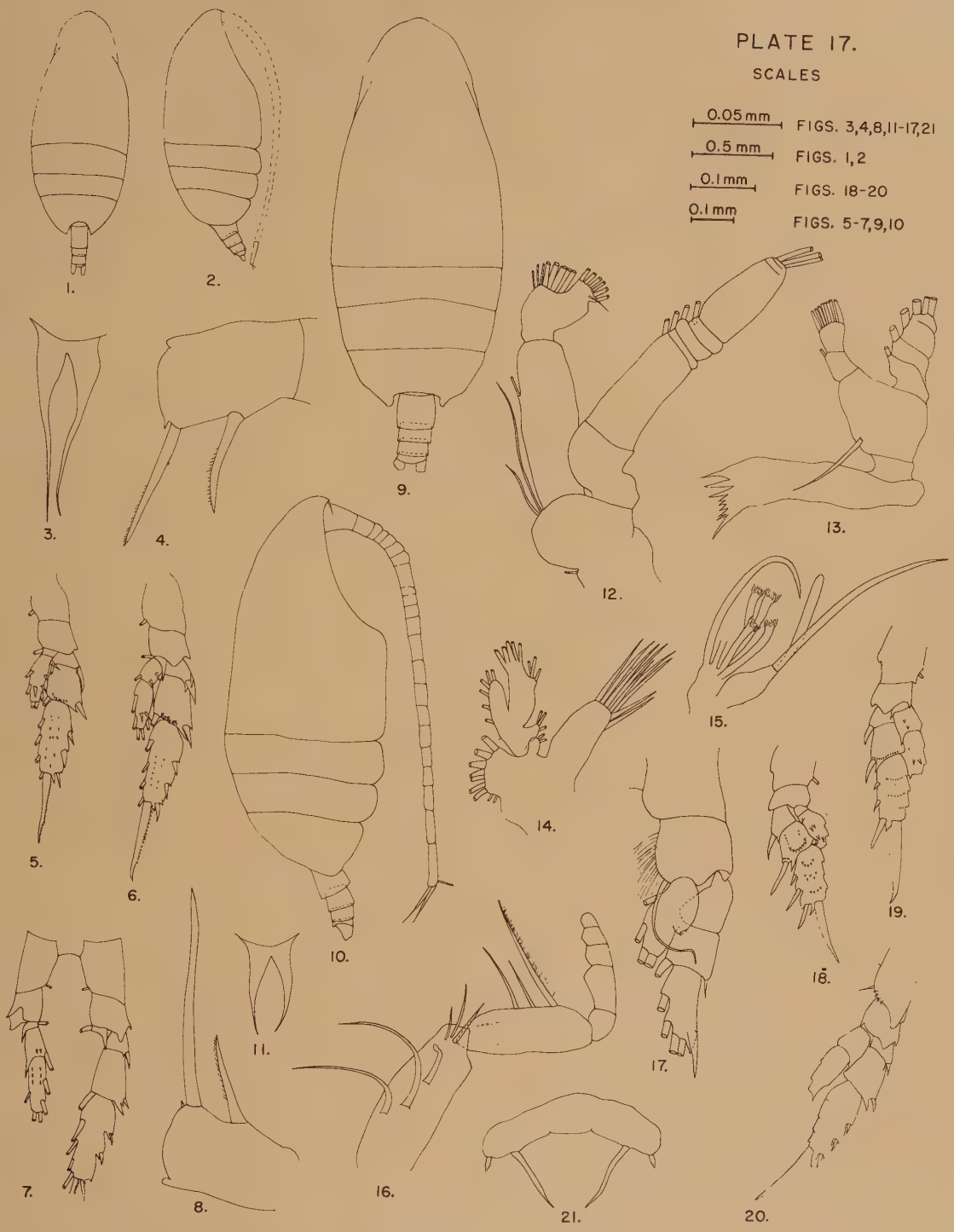


PLATE 17.—(1) *Scolecithricella vittata*, female, dorsal view; (2) lateral view; (3) rostrum; (4) fifth foot; (5) second foot; (6) third foot; (7) fourth pair of feet (one exopod and one endopod missing); (8) fifth foot; (9) *S. tenuiserrata*, female, dorsal view; (10) lateral view; (11) rostrum; (12) second antenna; (13) mandible; (14) first maxilla; (15) terminal part of second maxilla; (16) maxilliped (setae on endopod not shown); (17) first foot; (18) second foot (setae not shown); (19) third foot (setae not shown); (20) fourth foot (setae not shown); (21) fifth pair of feet.

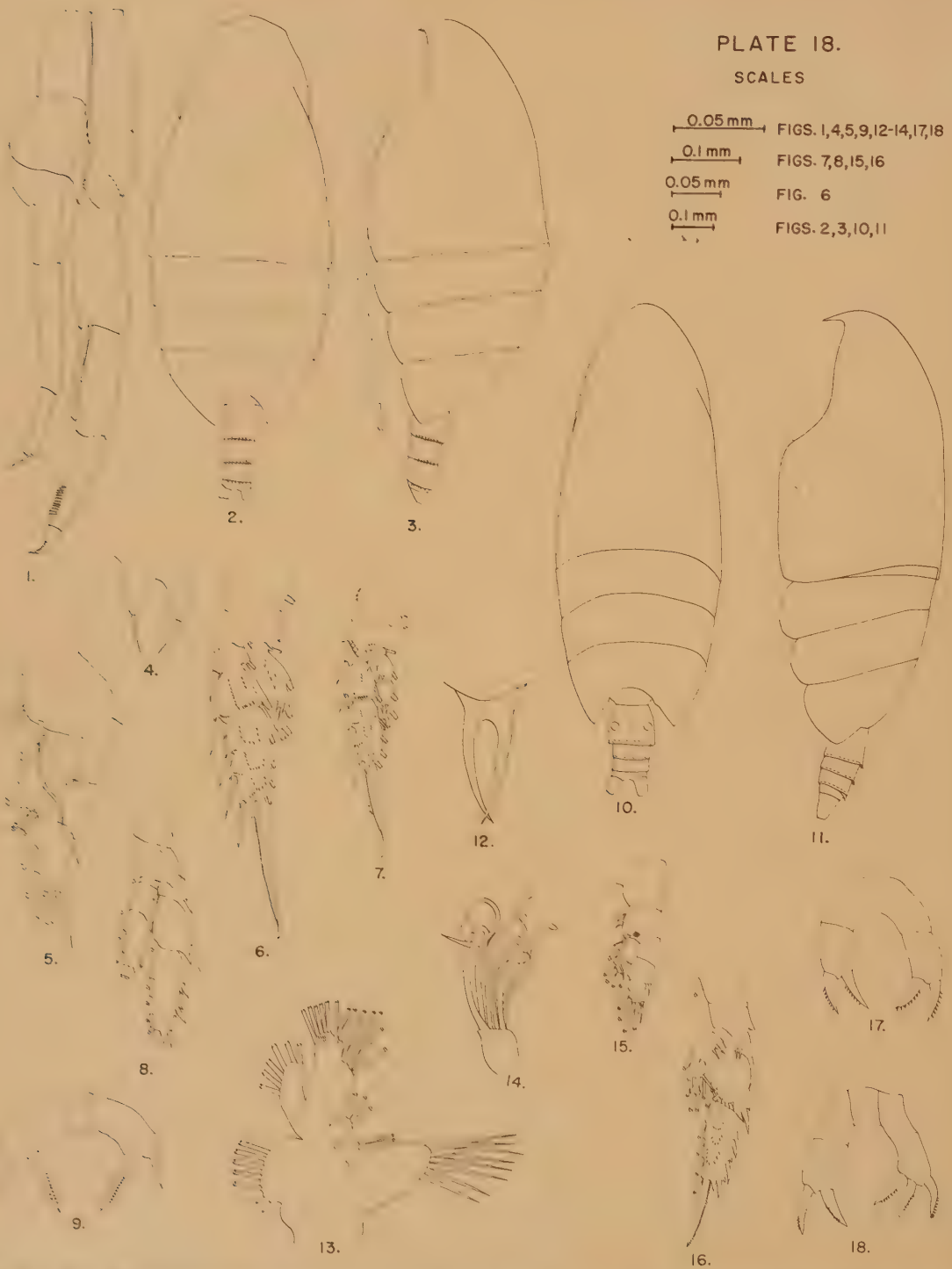


PLATE 18.—(1) *Scolecithricella tenuiserrata*, male, fifth pair of feet; (2) *S. marginata*, female, dorsal view; (3) lateral view; (4) rostrum; (5) first foot; (6) second foot; (7) third foot; (8) fourth foot; (9) fifth pair of feet; (10) *Scolecithricella tropica* n. sp., female, dorsal view; (11) lateral view; (12) rostrum; (13) first maxilla; (14) terminal part of second maxilla; (15) first foot; (16) second foot; (17) fifth pair of feet; (18) fifth pair of feet, abnormal (figs. 10–18 of paratype).

| essel: | Station | Occurrence |
|---|---|---|
| *Hugh M. Smith* | 144 | 1 female, 1.08 mm.; 1 male, 1.17 mm. |
| Do | 178 | 4 females, 1.05–1.10 mm.; 4 males, 1.0–1.27 mm. |
| Do | 31 | present. |
| *Stranger* | 34 | 3 females, 1.02–1.10 mm. |

Remarks: Because of the difficulty encountered in identifying this species, I have included several figures of the female and a figure of the fifth feet of a specimen that I consider to be the male of this species. Giesbrecht and Schmeil (1898) stated that the second basal segment of the first maxilla of the female has 3 setae. The present specimens have 3 setae on this segment. Although these authors indicated that the male of this species is questionable, they gave the length as 1.45 mm. as compared to 1.15 mm. for the female. The present males are also larger than the females.

*Scolecithricella marginata* (Giesbrecht, 1888)

(Plate 18, figs. 2–9)

Pacific records: Scott, 1909; Wilson, 1942.

| essel: | Station | Occurrence |
|---|---|---|
| *Hugh M. Smith* | 144 | 2 females, 1.05 mm. |
| Do | 178 | 2 females, 1.00, 1.02 mm. |

Remarks: The small size and fifth feet (fig. ) serve to identify this species.

*Scolecithricella tropica* n. sp.

(Plate 18, figs. 10–18)

| essel: | Station | Occurrence |
|---|---|---|
| *Hugh M. Smith* | 94 | 4 females, 1.22–1.30 mm. |
| Do | 132 | 5 females, 1.15–1.27 mm. |
| Do | 178 | 2 females, 1.13, 1.14 mm. |

Description: Of the 11 specimens of this pecies examined, none was intact. The following description is based, therefore, on several specimens and even with these a discussion of certain appendages will not be possible. The cephalothorax is considerably longer han the abdomen, the ratio of these two body arts is approximately 4.4: 1.0 (figs. 10, 11). The posterior thoracic border has a well-defined indentation at a point just anterior to the apex. The genital segment is longer than the combined lengths of the next 2 segments. The rostral filaments are long and apparently not articulated to the base (fig. 12).

The first maxilla (fig. 13) has the following number of setae: 2 on the second inner lobe, 3 on the third inner lobe, 5 on the second basal segment, 8 on the endopod, and 6 on the exopod.

The terminal portion of the second maxilla (fig. 14) has 5 sensory and 3 worm-like appendages.

The first pair of feet (fig. 15) has a 3-segmented exopod and 1-segmented endopod. A group of small spines is present on the second basal segment near the distal margin. The exopod of the second pair of feet consists of 3 segments and the endopod of 2 segments (fig. 16). Two spines are present on the surface of the first exopodal segment, a group of large and small spines on the second segment and three groups of spines on the third exopodal segment. Five large and 2 small spines are present on the second endopodal segment.

As in certain other species of *Scolecithricella*, the fifth feet are variable. Most of the specimens examined have 2, approximately equal, terminal spines (fig. 17) but at least 2 specimens were observed to have 3 on one side and 2 on the other (fig. 18).

This species is distinguished from other species of *Scolecithricella* by the indentation on the posterior thoracic margin and the structure of the fifth feet.

Remarks: An undissected female from Station 94 was selected as the holotype (U.S.N.M. No. 104, 416). This specimen and 6 paratypes (Nos. 104, 417–104, 419) have been deposited in the U.S. National Museum.

*Scolecithricella* sp.

(Plate 19, figs. 1–5)

| Vessel: | Station | Occurrence |
|---|---|---|
| *Hugh M. Smith* | 144 | 2 males, 1.20, 1.22 mm. |

Remarks: Two male specimens which are apparently referable to the genus *Scolecithri-*

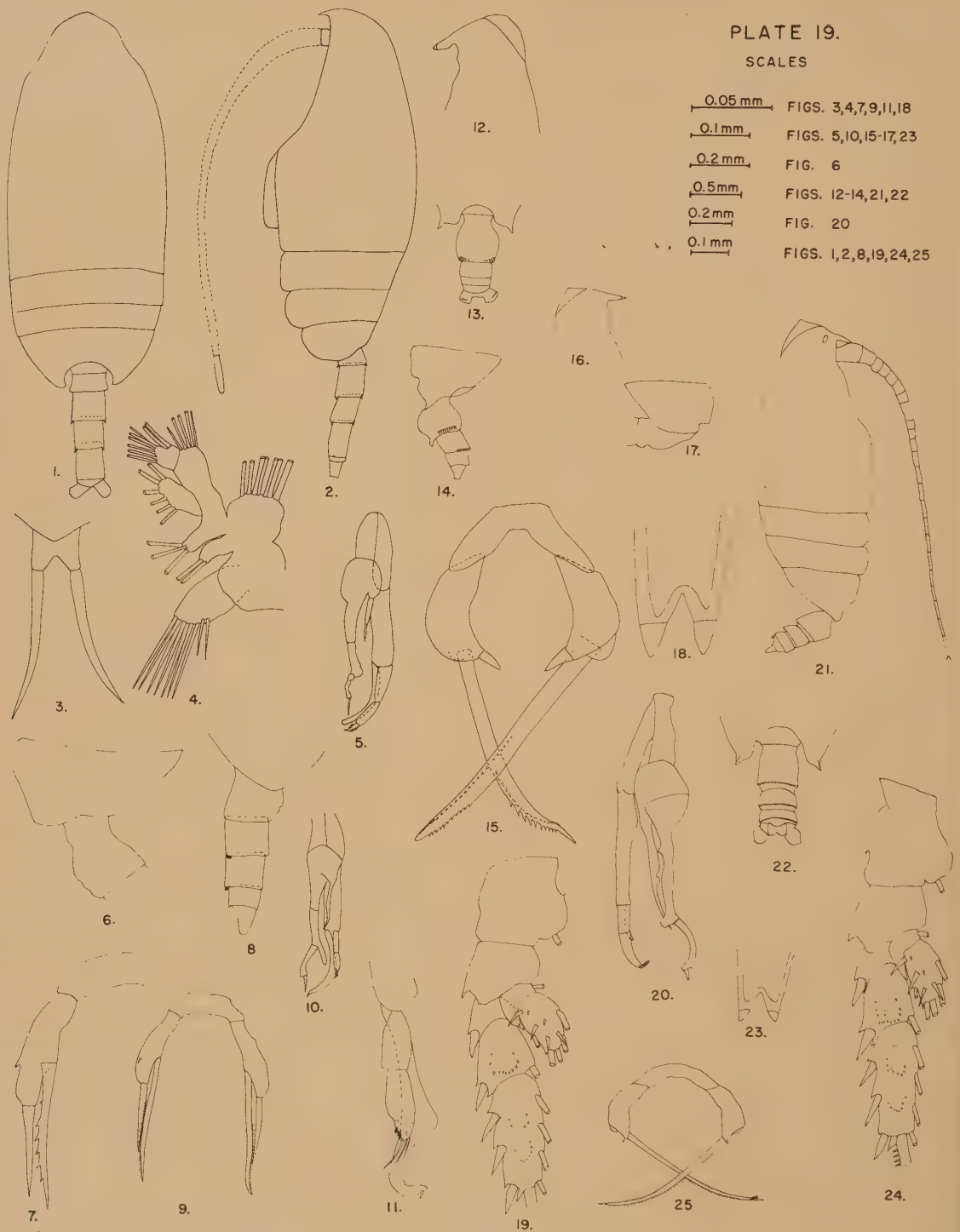


PLATE 19.—(1) *Scolecithricella sp.*, male, dorsal view; (2) lateral view; (3) rostrum; (4) first maxil (5) fifth pair of feet; (6) *Scaphocalanus echinatus*, female, posterior part of thorax and genital segment; (7) fi foot; (8) *S. longifurca*, female, posterior part of thorax and abdomen, lateral view; (9) fifth pair of feet; (10) m fifth pair of feet; (11) left fifth foot; (12) *Scottocalanus securifrons*, female, forehead, lateral view; (13) abdom dorsal view; (14) posterior part of thorax and abdomen, lateral view; (15) fifth pair of feet; (16) *S. farrani*, m forehead, lateral view; (17) posterior part of thorax and genital segment, lateral view; (18) rostrum; (19) sec foot; (20) fifth pair of feet; (21) *S. sedatus*, female, lateral view; (22) abdomen, dorsal view; (23) rostru (24) second foot; (25) fifth pair of feet.

*la* were found in the above sample. As the les of several described females, including preceding species, are not known, I hesitate describe the present species as new.

*Scaphocalanus echinatus* (Farran, 1905)

(PLATE 19, FIGS. 6, 7)

Pacific records: Farran, 1929, 1936; Mori, 1937; lson, 1950; Honjo, 1952; Tanaka, 1953; Tsuruta and iba, 1954a; Chiba, 1956; Honjo et al., 1957.

| Vessel: | Station | Occurrence |
|---|---|---|
| *Hugh M. Smith* | 63 | 1 female, 2.00 mm. |

Remarks: *S. echinatus* resembles *S. longi-rca* but the inner edge setae on the fifth feet the former species are coarsely toothed (fig.

*Scaphocalanus longifurca* (Giesbrecht, 1888)

(PLATE 19, FIGS. 8–11)

Pacific records: Tanaka, 1953. As *Scolecithricella gifurca*, Scott, 1909. As *?Scaphocalanus gracili-da*, Tanaka, 1937.

| Vessel: | Station | Occurrence |
|---|---|---|
| *Hugh M. Smith* | 94 | 1 male, 1.53 mm. |
| Do | 29 | 2 females, 1.87, 1.94 mm. |
| Do | 63 | 1 female, 1.94 mm. |

Remarks: The similarity of this species to *subbrevicornis* has been pointed out by Far-n (1929) and Vervoort (1951). The latter thor has indicated that Tanaka's *S. gracili-da* (male) is identical to a male doubtfully erred by Rose (1942) to *S. dentata*. Ver-ort (1951) suggests that these two males may the male of *S. longifurca*. I, too, have found male specimen which I am tentatively refer-g to *S. longifurca* rather than to *S. subbre-ornis*, as figured by Vervoort, because of the all size of the present specimen (1.53). Ver-ort's specimens measured 2.19 mm. and Tan-a's single specimen was 1.75 mm. The former author has also suggested (1957) that Wilson's (1950) records of *S. subbrevicornis* are probably referable to *S. longifurca*.

*Scottocalanus securifrons* (T. Scott, 1894)

(PLATE 19, FIGS. 12–15)

Pacific records: Scott, 1909; Farran, 1929; Tanaka, 1937; Brodsky, 1950; Wilson, 1950; Tanaka, 1953; Hida and King, 1955; Heinrich, 1958b.

| Vessel: | Station | Occurrence |
|---|---|---|
| *Horizon* | 32 | 1 female, 4.08 mm. |

Remarks: The ventral surface of the genital segment is produced posteriorly and partly overlaps the following segment (fig. 14). The spine on the left fifth foot is thicker than that on the right (fig. 15). These two characters will identify the female of this species. No male has been found in the present samples.

*Scottocalanus farrani* A. Scott, 1909

(PLATE 19, FIGS. 16–20)

Pacific records: Scott, 1909; Wilson, 1950.

| Vessel: | Station | Occurrence |
|---|---|---|
| *Hugh M. Smith* | 29 | 1 male, 3.50 mm. |

Remarks: The structure of the fifth pair of feet particularly the relative lengths of the exo- and endopods and the presence of a tooth-like process on the second basal segment of the right foot will identify the male of this species. No females were found.

*Scottocalanus sedatus* Farran, 1936

(PLATE 19, FIGS. 21–25)

Pacific records: Farran, 1936.

| Vessel: | Station | Occurrence |
|---|---|---|
| *Hugh M. Smith* | 29 | 1 female, 3.40 mm. |
| *Orsom* | 10 | 1 female, 3.30 mm. |

Remarks: This species is distinguished by the long setae and small, outwardly directed spines on the terminal segments of the fifth pair of feet (fig. 25).

Family TEMORIDAE

*Temoropia mayumbaensis* T. Scott, 1894

(PLATE 20, FIGS. 1–12)

Pacific records: Scott, 1909; Farran, 1929; 1936; lson, 1942; Heinrich, 1957b.

| Vessel: | Station | Occurrence |
|---|---|---|
| *Hugh M. Smith* | 94 | 6 females, 0.94–0.99; 3 males, 0.88–0.92 mm. |
| *Orsom* | 10 | 2 females, 0.98 mm. |

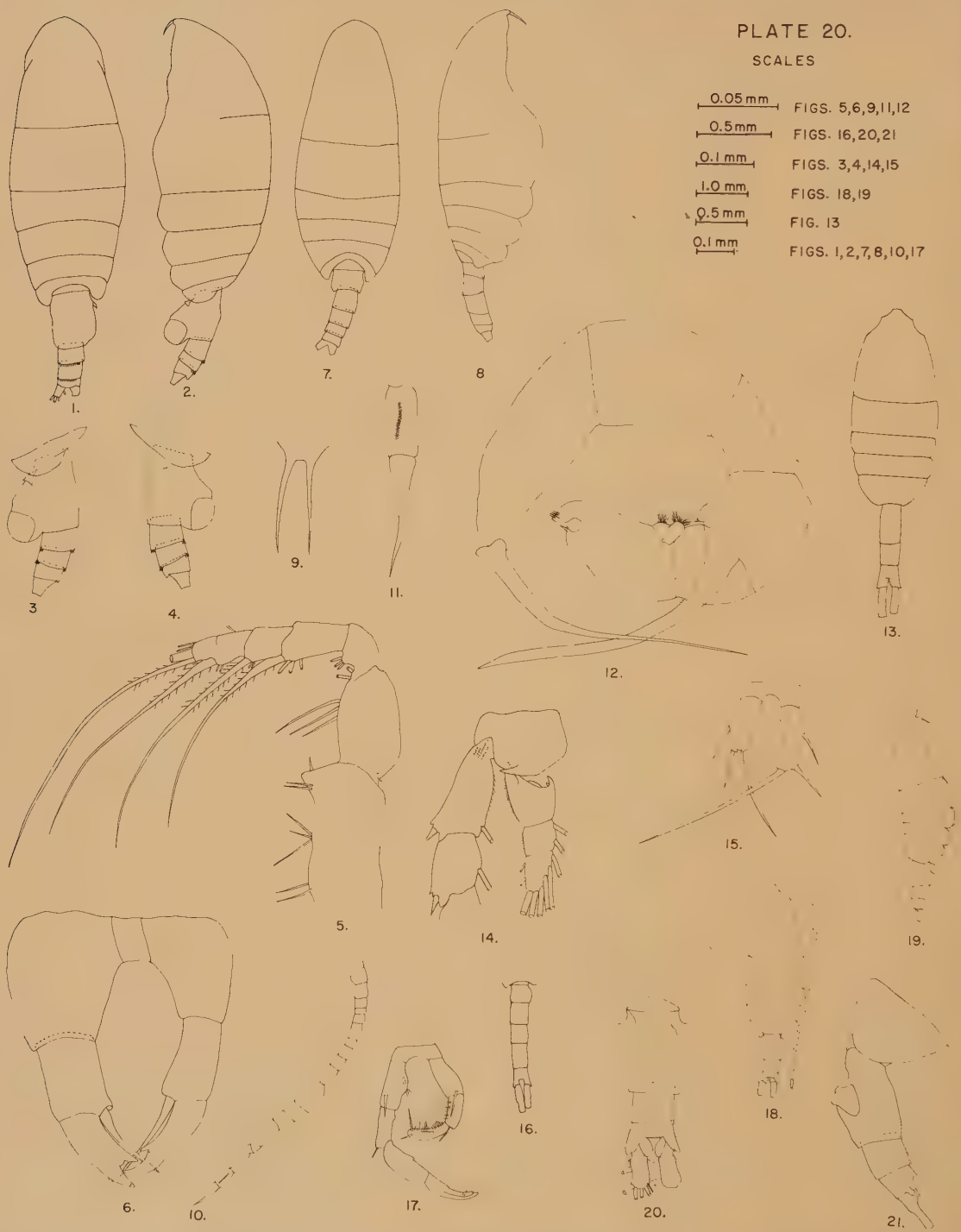


PLATE 20.—(1) *Temoropia mayumbaensis,* female, dorsal view; (2) lateral view; (3) posterior part of thorax and abdomen, left side; (4) posterior part of thorax and abdomen, right side; (5) maxilliped; (6) fifth pair of feet; (7) male, dorsal view; (8) lateral view; (9) rostrum; (10) first antenna; (11) distal two segments of first antenna; (12) fifth pair of feet; (13) *Metridia venusta,* female, dorsal view; (14) second foot (third exopodal segment omitted); (15) fifth pair of feet; (16) male, abdomen, dorsal view; (17) fifth pair of feet; (18) *Pleuromamma xiphias,* female, dorsal view; (19) lateral view; (20) posterior part of thorax and abdomen, dorsal view; (21) posterior part of thorax and abdomen, lateral view.

Remarks: The small size and large ventral rotrusion on the genital segment (figs. 3, 4) ill identify the female. The geniculate right antenna and the pointed terminal segment of this antenna (figs. 10, 11) will aid in recognizing the male sex.

Family METRIDIIDAE

*Metridia venusta* Giesbrecht, 1889

(PLATE 20, FIGS. 13–17)

Pacific records: Vervoort, 1957.

| Vessel: | Station | Occurrence |
|---|---|---|
| *Hugh M. Smith* | 144 | 1 juvenile female, 2.88 mm.; 1 male, 2.82 mm. |

Remarks: This species is recognized by the symmetrical furca. In both sexes the left rca is longer than the right one (figs. 13, 16).

*Pleuromamma xiphias* (Giesbrecht, 1888)

(PLATE 20, FIGS. 18–21, PLATE 21, FIGS. 1–5)

Pacific records: Vervoort, 1957. Also, Johnson, 42; Mori, 1942; Brodsky, 1950; Anraku, 1952; Honjo, 52; Anraku, 1954b; Tsuruta and Chiba, 1954a; 54b; Chiba, Tsuruta, and Maéda, 1955; Hida and ing, 1955; Nagaya et al., 1955; Chiba, 1956; Heinch, 1957b; Honjo et al., 1957; Heinrich, 1958b; amazi, 1958a.

| Vessel: | Station | Occurrence (measurements in mm.; number of specimens in paren.) | | | |
|---|---|---|---|---|---|
| | | | f. *typica* | f. *edentata* | f. *abyssalis* |
| | | female | male | female | male |
| *Hugh M. Smith* | 94 | 3.02(2) | | | |
| Do | 29 | | 3.13(1) | 2.75–3.06(11) | 3.06(1) |
| Do | 63 | | | 2.75–2.82(2) | |
| *Orsom* | 10 | | 2.79–3.02(3) | | |
| *Horizon* | 32 | 3.06(1) | | | |
| *Satsuma* | 32 | 2.85–3.13(5) | 2.99–3.06(4) | | |

Remarks: All three forms of this species appeared in the above cited samples. Figures nd descriptions of these have been presented y Steuer (1932). The female of forma *abyslis* is not known. The female of forma *typica* nd forma *edentata* are distinguished by the eth on the first and second antennal segments. In forma *typica* these segments each as a large tooth (fig. 6) while in forma *edenta* these segments have only small teeth (fig. 0). Although Steuer mentions that segment 6 of the first antenna is smaller than segment 7 in forma *edentata*, these length differences re difficult to observe.

The male of forma *edentata* is unknown. Forma *typica* is easily recognized by the greatly asymmetrical and hairy abdomen (fig. 7) while the male of forma *abyssalis* has a less asymmetrical and less hairy abdomen (fig. 12). The small tooth on segment 17 (fig. 13) makes this specimen referable to what Steuer termed subform *thermophila* of forma *abyssalis*.

*Pleuromamma abdominalis* (Lubbock, 1856)

(PLATE 21, FIGS. 6–15)

Pacific records: Vervoort, 1957. Also, Johnson, 1942; Mori, 1942; Brodsky, 1950; Anraku, 1952; Honjo, 1952; Anraku, 1954a; 1954b; Tsuruta and Chiba, 1954b; Chiba, Tsuruta, and Maéda, 1955; Hida and King, 1955; Nagaya et al., 1955; Chiba, 1956; Heinrich, 1957b; Honjo et al., 1957; Heinrich, 1958a; Yamazi, 1958a.

| Vessel: | Station | Occurrence |
|---|---|---|
| *Hugh M. Smith* | 63 | 1 male, 4.28 mm. |
| *Orsom* | 10 | 2 females, 3.99, 4.08 mm.; 2 males, 3.99, 4.08 mm. |
| *Satsuma* | 32 | 1 female, 4.25 mm.; 1 male, 4.18 mm. |

Remarks: The large spine-like protrusion on the forehead of this species (figs. 19, 3) readily distinguishes it from other species in the genus.

*Pleuromamma indica* Wolfenden, 1905

(PLATE 22, FIGS. 1–7)

Pacific records: Tanaka, 1953.

| Vessel: | Station | Occurrence |
|---|---|---|
| *Satsuma* | 32 | 1 male, 2.04 mm. |

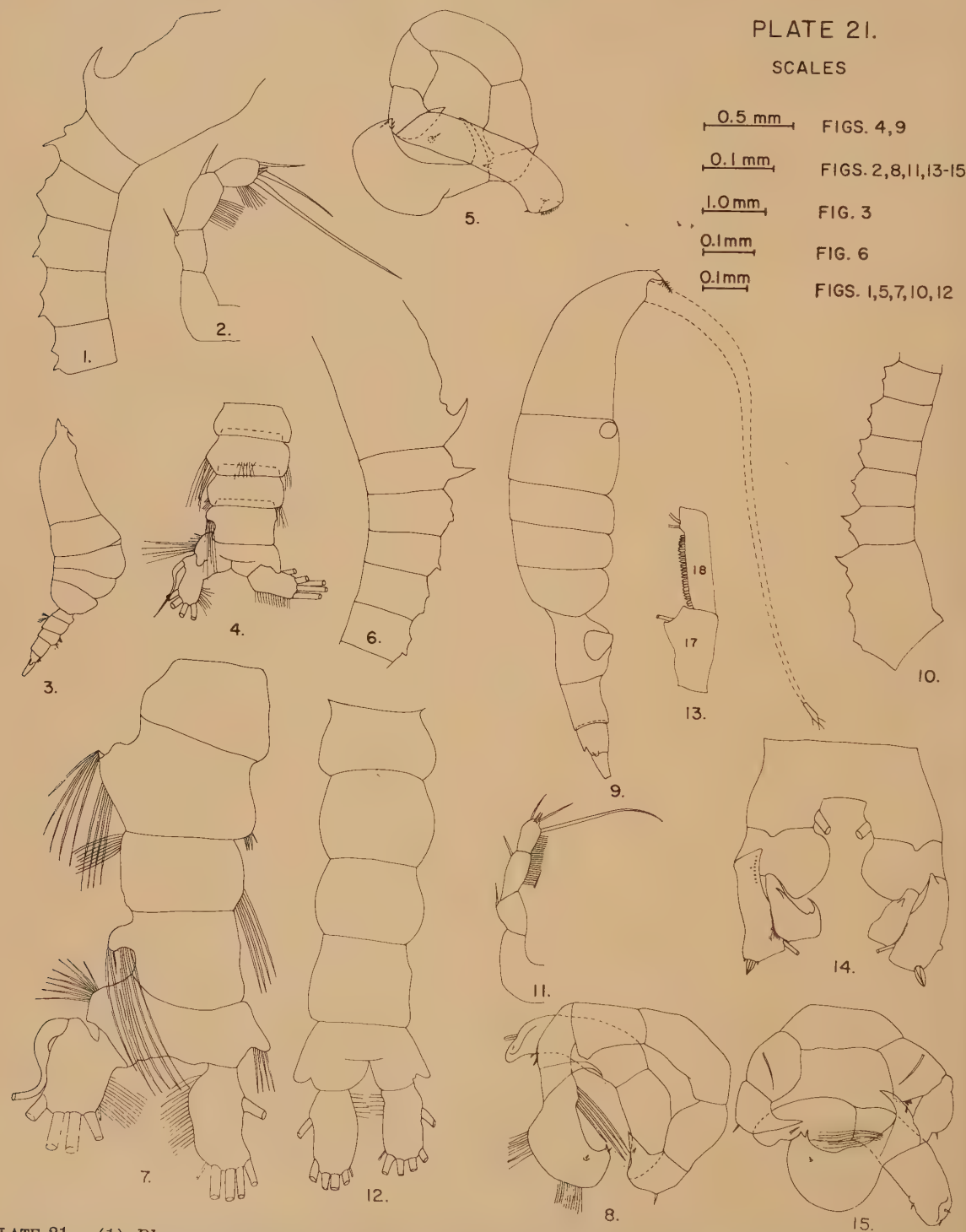


PLATE 21.—(1) *Pleuromamma xiphias*, female, proximal part of first antenna; (2) fifth foot; (3) male, later view; (4) abdomen, dorsal view; (5) fifth pair of feet; (6) *P. abdominalis* f. *typica*, female, proximal part first antenna; (7) male, abdomen, dorsal view; (8) fifth pair of feet; (9) *P. abdominalis* f. *edentata*, fema lateral view; (10) proximal part of first antenna; (11) fifth foot; (12) *P. abdominalis* f. *abyssalis*, male, abdome dorsal view; (13) segments 17 and 18 of right first antenna; (14) second pair of feet (distal end of exopods a endopods not shown); (15) fifth pair of feet.

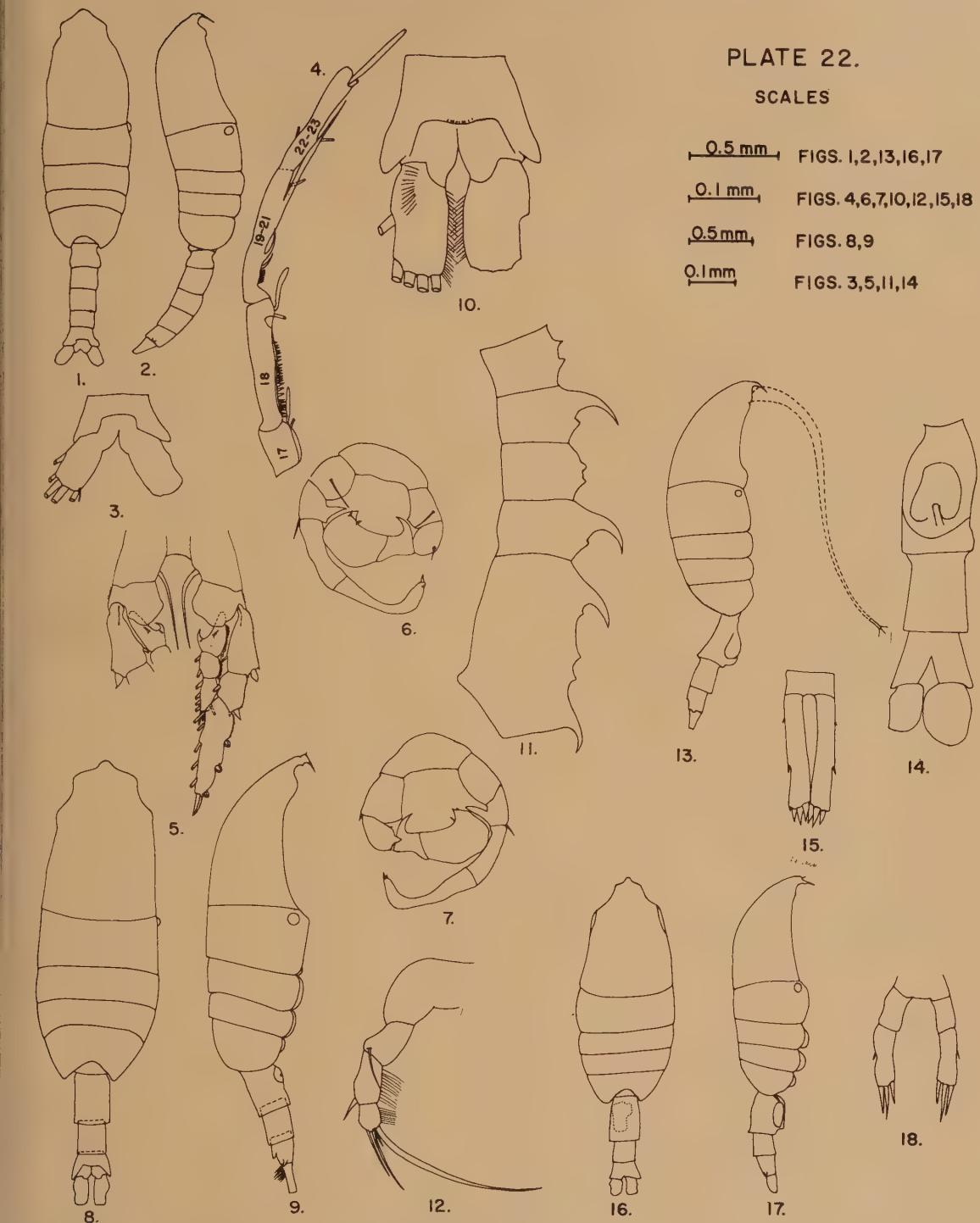


PLATE 22.—(1) *Pleuromamma indica*, male, dorsal view; (2) lateral view; (3) anal segment and furcae, sal view; (4) segments 17 to 23 of right first antenna; (5) second pair of feet (only part of one foot shown); fifth pair of feet, anterior side; (7) posterior side; (8) *P. quadrungulata* f. *typica*, female, dorsal view; lateral view; (10) anal segment and furcae, dorsal view; (11) proximal part of first antenna; (12) fifth foot; ) *P. gracilis* f. *minima*, female, lateral view; (14) abdomen, ventral view; (15) fifth pair of feet; (16) *P. ealis*, female, dorsal view; (17) lateral view; (18) fifth pair of feet.

Remarks: Only a single male of this species was found. It is distinguished from males of *abdominalis* and other species by the symmetrical abdomen (fig. 1), divergent furcae (fig. 3) and absence of teeth on segment 17 of the right first antenna (fig. 4). The first segment of both endopods of *indica* are indented and claw-like (fig. 5) in contradistinction to *abdominalis* which has this claw-like indentation on only one endopod.

*Pleuromamma quadrungulata* (Dahl, 1893)

(PLATE 22, FIGS. 8–12)

Pacific records: Vervoort, 1957. Also, Brodsky, 1950.

| Vessel: | Station | Occurrence |
|---|---|---|
| *Hugh M. Smith* | 29 | 1 female, 3.77 mm. |
| Do | 63 | 1 female, 3.51 mm. |

Remarks: The above specimens are referable to forma *typica* Steuer, 1932. It is distinguished from forma *psychrophila* Steuer, 1931, by the presence of a large curved tooth on the fourth segment of the first antennae (fig. 11). In forma *psychrophila* this tooth is reduced in size and not curved.

*Pleuromamma gracilis* (Claus, 1863)

(PLATE 22, FIGS. 13–15)

Pacific records: Esterly, 1905; Scott, 1909; Farran, 1929; 1936; Mori, 1937; Tanaka, 1937; Dakin and Colefax, 1940; Johnson, 1942; Mori, 1942; Wilson, 1942; Brodsky, 1950; Wilson, 1950; Anraku, 1952; Honjo, 1952; Tanaka, 1953; Anraku, 1954b; Tsuru and Chiba, 1954b; Chiba, Tsuruta, and Maéda, 195 Nagaya et al., 1955; Chiba, 1956; Heinrich, 1957 Honjo et al., 1957; Heinrich, 1958a; 1958b; Yama 1958a.

| Vessel: | Station | Occurrence |
|---|---|---|
| *Hugh M. Smith* | 94 | 1 female, 1.80 mm. |
| Do | 29 | 6 females, 2.01–2.07 mm. |
| Do | 63 | 1 female, 1.90 mm. |
| *Horizon* | 32 | 1 female, 1.94 mm. |
| *Satsuma* | 32 | 1 female, 1.97 mm. |

Remarks: All the specimens obtained of th species are referable to Steuer's (1932) form *minima*. This form is distinguished from form *piseki* (Farran, 1929) and *maxima* (Steue 1932) by the divergent margins of the an segment (fig. 14) and by the fused second bas and exopodal segments of the fifth feet (fi 15). In most of the present specimens the le furca is enlarged (fig. 14).

*Pleuromamma borealis* (Dahl, 1893)

(PLATE 22, FIGS. 16–18)

Pacific records: Farran, 1929; Brodsky, 1950; W son, 1950.

| Vessel: | Station | Occurrence |
|---|---|---|
| *Hugh M. Smith* | 63 | 1 female, 2.01 mm. |
| *Orsom* | 10 | 1 female, 1.83 mm. |
| *Satsuma* | 32 | 2 females, 1.90 mm. |

Remarks: The long spines on the fifth fe of the female (fig. 18) distinguished this sp cies from the preceding one.

Family CENTROPAGIDAE

*Centropages gracilis* (Dana, 1849)

(PLATE 23, FIGS. 1–3)

Pacific records: Scott, 1909; Yamada, 1933; Farran, 1936; Mori, 1937; Dakin and Colefax, 1940; Mori, 1942; Wilson, 1950; Tanaka, 1953; Tsuruta and Chiba, 1954b; Chiba, Tsuruta, and Maéda, 1955; Nagaya et al., 1955; Chiba, 1956; Honjo et al., 1957; Yamazi, 1958a.

| Vessel: | Station | Occurrence |
|---|---|---|
| *Hugh M. Smith* | 132 | 3 females, 1.90–1.97 mm. |
| Do | 153 | present. |
| Do | 178 | 2 females, 2.00 mm. |
| Do | 30 | 3 females, 1.97–2.01 mm.; 1 male, 2. mm. |
| *Stranger* | 34 | 1 female, 1.90 mm. |
| *Satsuma* | 32 | 1 male, 1.84 mm. |

Remarks: The female is recognized by t spines on the sides on the second abdomin segment and the short spine-like protrusio on the inner sides of the second exopodal se ments (fig. 1) of the fifth feet. The thumb the chela of the right foot of the male has

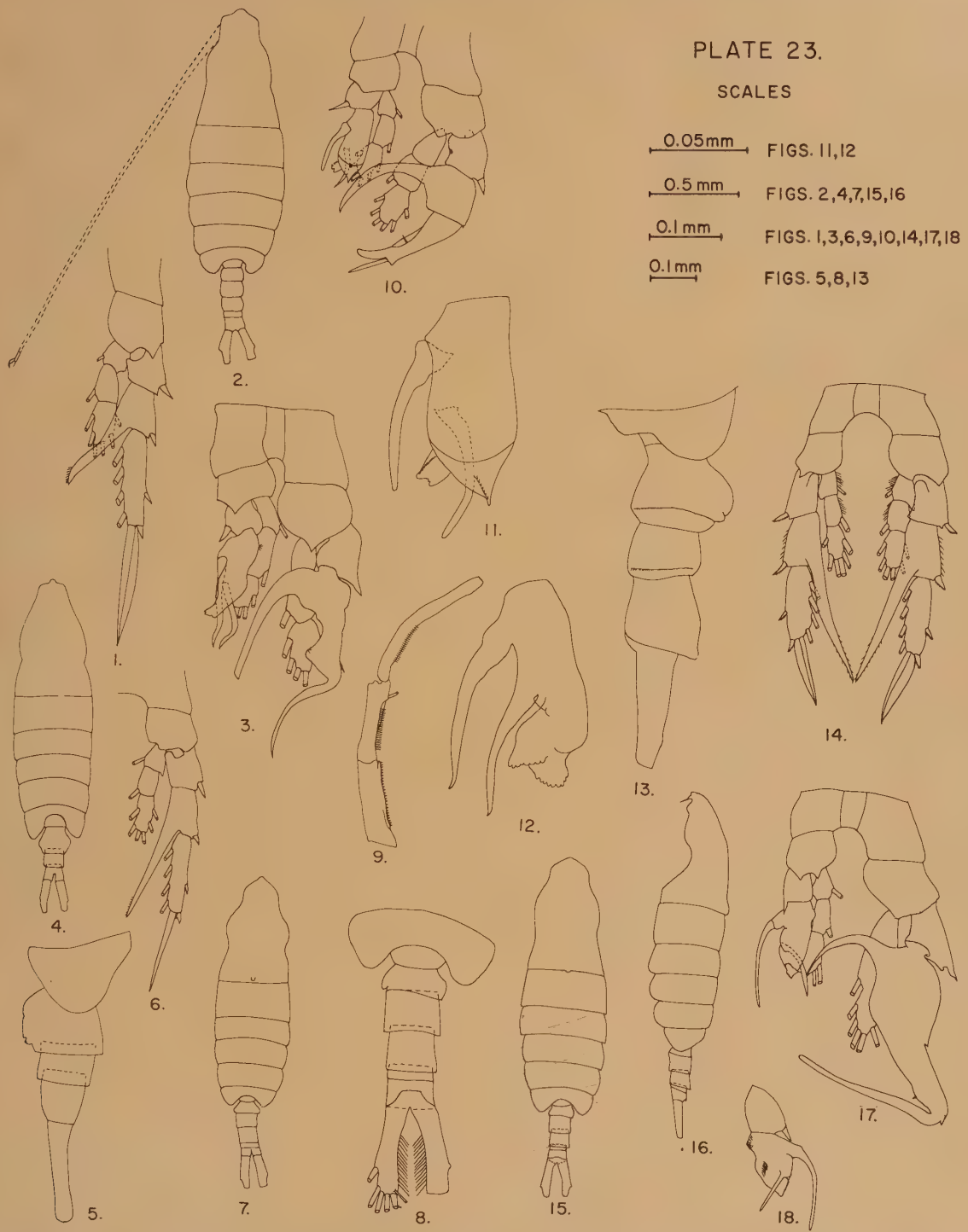


PLATE 23.—(1) *Centropages gracilis,* female, fifth foot; (2) male, dorsal view; (3) fifth pair of feet; (4) *C. elongatus,* female, dorsal view; (5) posterior part of thorax and abdomen, lateral view; (6) fifth foot; (7) male, dorsal view; (8) posterior part of thorax and abdomen, dorsal view; (9) segments 17 to 21 of right first antenna; (10) fifth pair of feet; (11) terminal part of exopod of left fifth foot; (12) terminal part of exopod of left fifth foot, other side; (13) *C. calaninus,* female, posterior part of thorax and abdomen, lateral view; (14) fifth pair of feet; (15) male, dorsal view; (16) lateral view; (17) fifth pair of feet; (18) exopod of left fifth foot.

pronounced triangular protrusion which is absent in other species in the genus (fig. 3).

*Centropages elongatus* Giesbrecht, 1896

(PLATE 23, FIGS. 4–12)

Synonymy:

*Centropages pacificus* Chiba, 1956, Jour. Shimonoseki College of Fisheries, 6(1): 47–48.

Pacific records: Scott, 1909; Mori, 1937; 1942; Wilson, 1942; Johnson, 1954; Tsuruta and Chiba, 1954b; Chiba, Tsuruta, and Maéda, 1955; Nagaya et al., 1955; Yamazi, 1958a.

| Vessel: | Station | Occurrence |
|---|---|---|
| *Hugh M. Smith* | 153 | 1 female, 1.87 mm. |
| *Horizon* | 32 | 2 males, 1.74, 1.76 mm. |
| *Satsuma* | 32 | 1 female, 1.66 mm. |

Remarks: The female genital segment is only slightly asymmetrical (figs. 4, 5) and the abdomen lacks the spines which are present in the preceding species and in a related species (*C. violaceus*). The spine-like extensions of the second exopodal segments of the fifth feet exceed the distal end of the third exopodal segments (fig. 6). The male is recognized by the structure of the fifth feet, particularly the long external spine near the distal end of the thumb (fig. 10) and the form of the left exopod (figs. 11, 12).

Chiba (1956) has described a new species, *C. pacificus* (based on males), from specimens collected in the Bikini area. I believe these specimens are the males of *C. elongatus*, a species which has also been reported from Bikini by Johnson (1954).

Mori (1937) stated in his discussion of this species that the last thoracic segments of the female are pointed. He also presented a figure showing this point on one lateral margin. However, no mention was made of the pointed margins of the last thoracic segments by Giesbrecht (1896) in his original description of the species nor in the synopsis of this species presented later by Giesbrecht and Schmeil (1898). The latter authors stated that *C. elongatus* is related to *C. violaceus* which has round posterior thoracic margins. The present specimens also have rounded margins (fig. 5).

*Centropages calaninus* (Dana, 1849)

(PLATE 23, FIGS. 13–18)

Pacific records: Scott, 1909; Farran, 1936; Mori, 1937; Dakin and Colefax, 1940; Mori, 1942; Wilson, 1942; 1950; Tanaka, 1953; Tsuruta and Chiba, 1954b; Chiba, Tsuruta, and Maéda, 1955; Nagaya et al., 1955; Chiba, 1956; Gilmartin, 1958; Yamazi, 1958a.

| Vessel: | Station | Occurrence |
|---|---|---|
| *Hugh M. Smith* | 30 | 1 female, 2.18 mm.; 1 male, 2.06 mm. |
| *Horizon* | 32 | 3 females, 1.97–2.04 mm.; 5 males, 1.80–2.00 mm. |

Remarks: The anal segment of the female has a small knob on the ventral surface near the posterior end and the spine-like protrusions of the second exopodal segments of the fifth feet exceed the tip of the third exopodal segments (figs. 13, 14). The male is recognized by the structure of the fifth feet, especially the long and bent thumb of the chela (fig. 17).

Family LUCICUTIIDAE

*Lucicutia flavicornis* (Claus, 1863)

(PLATE 24, FIGS. 1–4)

Pacific records: Esterly, 1905; Scott, 1909; Farran, 1929; Mori, 1937; Dakin and Colefax, 1940; Johnson, 1942; Mori, 1942; Wilson, 1942; Davis, 1949; Brodsky, 1950; Wilson, 1950; Anraku, 1952; Honjo, 1952; Tanaka, 1953; Anraku, 1954b; Tsuruta and Chiba, 1954b; Chiba, Tsuruta, and Maéda, 1955; Motoda and Anraku, 1955; Nagaya et al., 1955; Chiba, 1956; Heinrich, 1957b; Honjo et al., 1957; Heinrich, 1958a; Yamazi, 1958a.

| Vessel: | Station | Occurrence |
|---|---|---|
| *Hugh M. Smith* | 94 | 12 females, 1.46–1.90 mm.; 7 males, 1.43–1.77 mm. |
| Do | 132 | 3 males, 1.29–1.66 mm. |
| Do | 144 | 4 females, 1.63–1.80 mm.; 5 males, 1.44–1.48 mm. |
| Do | 178 | 3 females, 1.36–1.53 mm.; 7 males, 1.28–1.42 mm. |

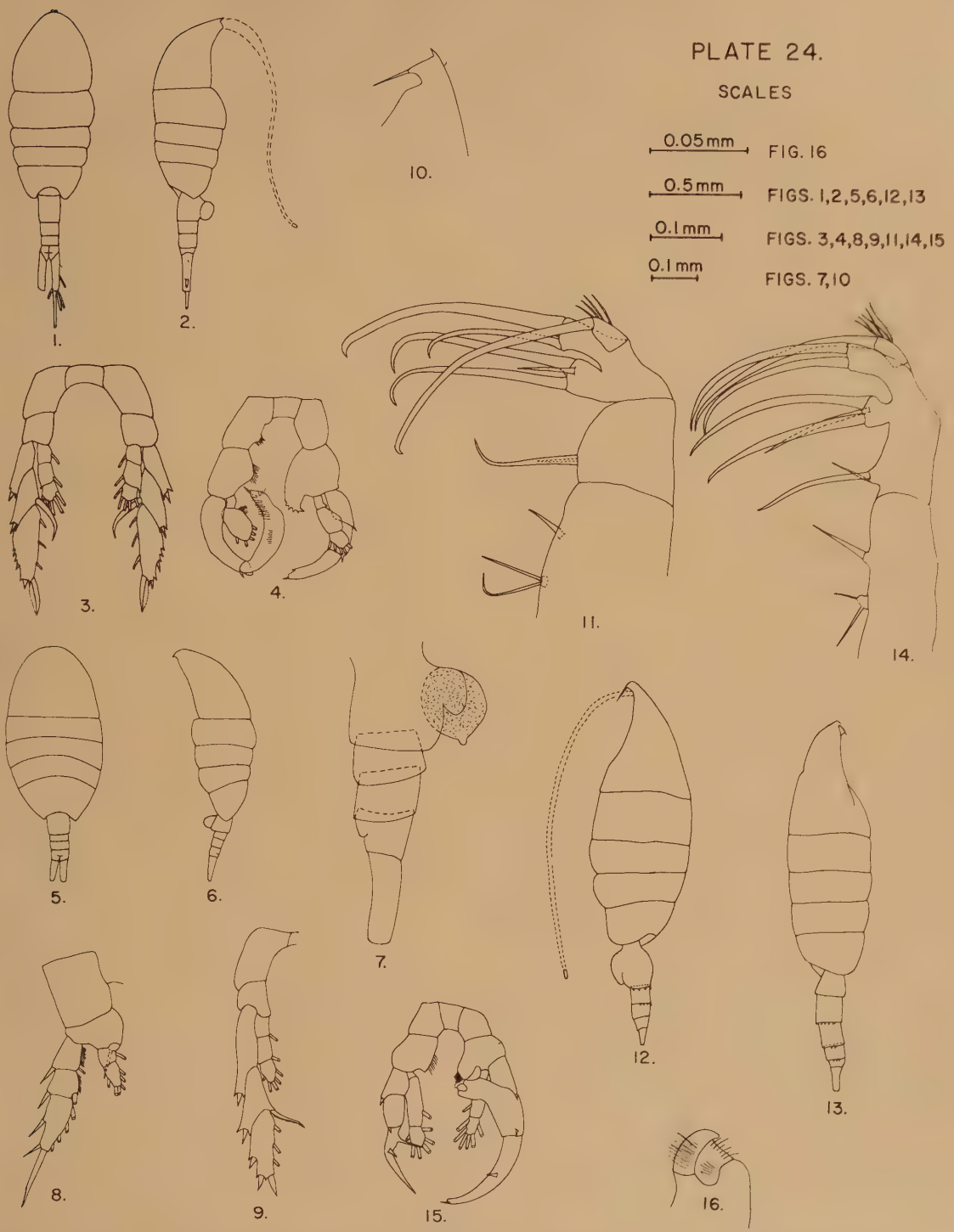


PLATE 24.—(1) *Lucicutia flavicornis*, female, dorsal view; (2) lateral view; (3) fifth pair of feet; (4) male, fifth pair of feet; (5) *L. ovalis*, female, dorsal view; (6) lateral view; (7) abdomen, lateral view; (8) first foot; (9) fifth foot; (10) *Heterorhabdus spinifrons*, female, forehead, lateral view; (11) second maxilla; (12) *H. papilliger*, female, lateral view; (13) male, lateral view; (14) second maxilla; (15) fifth pair of feet; (16) distal end of protrusion of second right exopodal segment.

| Vessel: | Station | Occurrence |
|---|---|---|
| Do | 31 | 3 females, 1.41–1.55 mm. |
| Do | 29 | present. |
| *Stranger* | 34 | 1 female, 1.39 mm. |
| *Satsuma* | 32 | 1 female, 1.26 mm. |

Remarks: The female is distinguished from other species of the genus by the short anal segment (figs. 1, 2) and by the form of the fifth feet (fig. 3). The male is recognized by the protrusion of the second basipodal segment of the left foot and the long terminal segment of the right exopod (fig. 4).

Other authors, including Farran, 1929, mention that considerable variation occurs in the length of this species. In at least one collection (*Smith* 94), two size groups were noted as follows: females 1.46–1.53 (6); 1.87–1.90 (6); males 1.39–1.53 (7); 1.77 (1) mm.

*Lucicutia ovalis* Wolfenden, 1911

(PLATE 24, FIGS. 5–9)

Pacific records: Farran, 1929; 1936; Mori, 1937; Wilson, 1950; Tanaka, 1953; Anraku, 1954b; Tsuruta and Chiba, 1954b; Chiba, Tsuruta, and Maéda, 1955; Motoda and Anraku, 1955; Nagaya et al., 1955; Chiba 1956; Honjo et al., 1957; Yamazi, 1958a.

| Vessel: | Station | Occurrence |
|---|---|---|
| *Hugh M. Smith* | 132 | 2 females, 1.32, 1.36 mm. |
| Do | 153 | 1 female, 1.37 mm. |
| Do | 178 | 3 females, 1.34–1.36 mm. |
| Do | 63 | 1 female, 1.46 mm. |
| *Stranger* | 34 | 1 female, 1.39 mm. |
| *Orsom* | 10 | present. |
| *Satsuma* | 32 | 1 female, 1.44 mm. |

Remarks: The female is most easily recog nized by its small size, the two-segmented endo pod of the first feet (fig. 8), and the structur of the fifth feet (fig. 9).

## Family HETERORHABDIDAE

*Heterorhabdus spinifrons* (Claus, 1863)

(PLATE 24, FIGS. 10–11)

Pacific records: Vervoort, 1957. Also, Brodsky, 1950; Tanaka, 1953.

| Vessel: | Station | Occurrence |
|---|---|---|
| *Hugh M. Smith* | 144 | present. |
| Do | 29 | 3 females, 2.69–3.57 mm.; 3 males, 3.04–3.20 mm. |
| Do | 63 | 1 male, 2.41 mm. |
| *Satsuma* | 32 | 3 females, 2.10–2.18 mm. |

Remarks: In both sexes the forehead is prolonged into a point (fig. 10), a character which will identify this species. In the female, one of the distal 3 spines of the maxilliped is small and slender (fig. 11).

*Heterorhabdus papilliger* (Claus, 1863)

(PLATE 24, FIGS. 12–16)

Pacific records: Esterly, 1905; Scott, 1909; Farran, 1929; 1936; Mori, 1937; Tanaka, 1937; Dakin and Colefax, 1940; Johnson, 1942; Mori, 1942; Wilson, 1942; Brodsky, 1950 Wilson, 1950; Anraku, 1952; Honjo, 1952; Tanaka, 1953; Anraku, 1954a; 1954b; 1954 Chiba, Tsuruta, and Maéda, 1955; Motoda and Anrak 1955; Nagaya et al., 1955; Chiba, 1956; Heinri 1957b; Yamazi 1958a.

| Vessel: | Station | Occurrence |
|---|---|---|
| *Hugh M. Smith* | 94 | 2 females, 2.04, 2.07 mm.; 3 males, 1.80–1.94 mm. |
| Do | 132 | 2 females, 1.87, 1.90 mm.; 1 male, 1.8 mm. |
| Do | 144 | 1 female, 2.14 mm.; 1 male, 2.11 mm. |
| Do | 178 | 6 females, 1.80–1.87 mm.; 6 males, 1.70–1.84 mm. |
| Do | 29 | 1 female, 2.00 mm. |
| Do | 31 | 4 females, 1.90–1.94 mm.; 1 male, 1.9 mm. |
| Do | 63 | 2 females, 1.77, 1.97 mm. |
| *Stranger* | 34 | 1 female, 1.94 mm. |
| *Orsom* | 10 | 1 female, 1.84 mm. |

Remarks: The female forehead is rounde (fig. 12) and the 3 distal spines of the maxill ped are all about equal in length in both sexe (fig. 14).

Family AUGAPTILIDAE

*Haloptilus acutifrons* (Giesbrecht, 1892)

(PLATE 25, FIGS. 1–8)

Pacific records: Vervoort, 1957. Also, Johnson, 1942; Brodsky, 1950; Tanaka, 1953; Anraku, 1954b; Chiba, Tsuruta, and Maéda, 1955; Nagaya et al., 1955; Chiba, 1956; Yamazi, 1958a.

| Vessel: | Station | Occurrence |
|---|---|---|
| *Hugh M. Smith* | 94 | 1 female, 3.80 mm. |

Remarks: Although closely resembling *H. oxycephalus, H. acutifrons* may be distinguished by (1) its small size, (2) less produced forehead (fig. 1) and (3) structure of the gnathal lobe of the mandible (fig. 3).

*Haloptilus fertilis* (*Giesbrecht,* 1892)

(PLATE 25, FIGS. 9–11)

Pacific records: none.

| Vessel: | Station | Occurrence |
|---|---|---|
| *Hugh M. Smith* | 32 | 1 male, 2.47 mm. |

Remarks: The male is recognized by its small size and structure of the fifth feet (fig. 1).

*Haloptilus longicornis* (Claus, 1863)

Pacific records: Scott, 1909; Farran, 1929; 1936; Mori, 1937; Johnson, 1942; Mori, 1942; Wilson, 1942; Brodsky, 1950; Wilson, 1950; Tanaka, 1953; Yamazi, 1953c; Chiba, Tsuruta, and Maéda, 1955; Nagaya et al., 1955; Chiba, 1956; Heinrich, 1957b; Honjo et al., 1957; Heinrich, 1958b; Yamazi, 1958a.

| Vessel: | Station | Occurrence |
|---|---|---|
| *Hugh M. Smith* | 94 | present. |
| Do | 132 | 9 females, 1.80–1.90 mm. |
| Do | 144 | present. |
| Do | 153 | Do |
| Do | 178 | Do |
| Do | 31 | Do |
| Do | 63 | Do |
| *Stranger* | 34 | Do |
| *Orsom* | 10 | Do |
| *Horizon* | 32 | Do |
| *Satsuma* | 32 | 5 females, 1.77–1.83 mm. |

Remarks: The long first antennae which exceed the end of the furca and the knob-like button on the forehead will identify the female. No males were found.

As the occurrence records indicate, this was a widespread species in the present collections. It was also the most abundant species of *Haloptilus* and occurred in fair numbers in several samples (*Smith* 94, 144, 31).

*Haloptilus ornatus* (Giesbrecht, 1892)

(PLATE 25, FIGS. 12–16)

Pacific records: Scott, 1909; Mori, 1937; Johnson, 1942; Wilson, 1942; Wilson, 1950; Tanaka, 1953; Anraku, 1954b; Chiba, Tsuruta, and Maéda, 1955; Nagaya et al., 1955; Chiba, 1956.

| Vessel: | Station | Occurrence |
|---|---|---|
| *Hugh M. Smith* | 63 | 1 female, 4.56 mm. |

Remarks: This is a large species and has a rounded forehead. As in other species of *Haloptilus,* the form of the gnathal lobe of the mandible is also diagnostic (fig. 13).

*Haloptilus spiniceps* (Giesbrecht, 1892)

(PLATE 25, FIGS. 17–20; PLATE 26, FIGS. 1–5)

Pacific records: Scott, 1909; Farran, 1929; 1936; Mori, 1937; Dakin and Colefax, 1940; Johnson, 1942; Wilson, 1942; 1950; Tanaka, 1953.

| Vessel: | Station | Occurrence |
|---|---|---|
| *Hugh M. Smith* | 94 | 1 female, 3.99 mm. |
| *Stranger* | 34 | 1 female, 3.70 mm. |
| *Orsom* | 10 | present. |
| *Horizon* | 32 | 1 female, 3.80 mm. |
| *Satsuma* | 32 | 1 female, 3.80 mm. |

Remarks: The short pointed forehead (fig. 17) which is curved downward in lateral view (fig. 18) and the structure of the gnathal lobe of the mandible (fig. 20) will identify the female of this species. No male has been found.

*Haloptilus austini* Grice, 1959

Pacific records: Grice, 1959.

| Vessel: | Station | Occurrence |
|---|---|---|
| *Hugh M. Smith* | 94 | 2 females, 3.16, 3.33 mm. |

Remarks: I have recently described this species. It has a rounded forehead and, as in other species of *Haloptilus,* the gnathal lobe of the mandible is diagnostic.

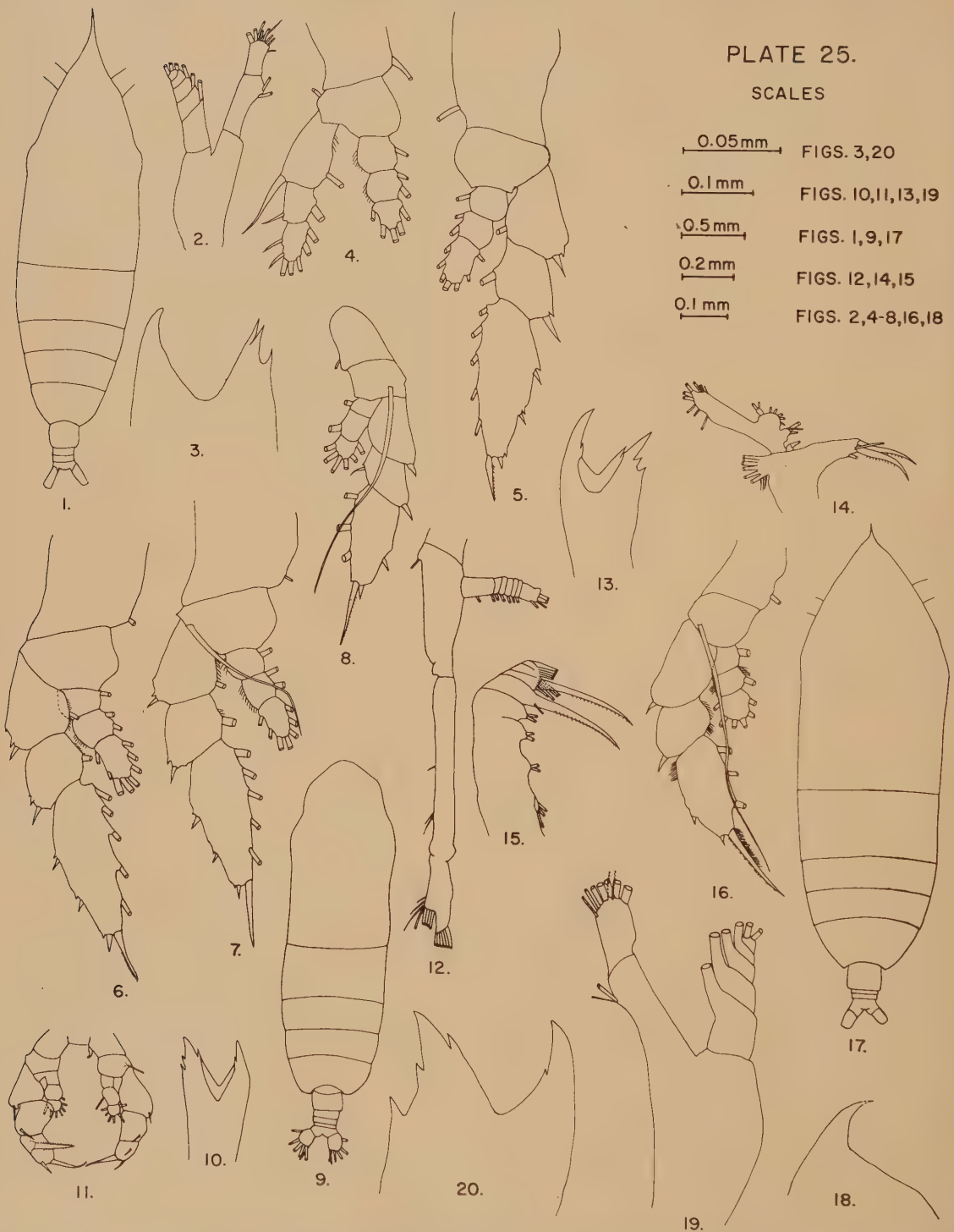


PLATE 25.—(1) *Haloptilus acutifrons*, female, dorsal view; (2) mandible palpus; (3) gnathal lobe of mandible; (4) first foot; (5) second foot; (6) third foot; (7) fourth foot; (8) fifth foot; (9) *H. fertilis*, male, dorsal view; (10) gnathal lobe of mandible; (11) fifth pair of feet; (12) *H. ornatus*, female, second antenna; (13) gnathal lobe of mandible; (14) first maxilla; (15) second maxilla; (16) fifth foot; (17) *H. spiniceps*, female, dorsal view; (18) forehead, lateral view; (19) mandible palpus; (20) gnathal lobe of mandible.

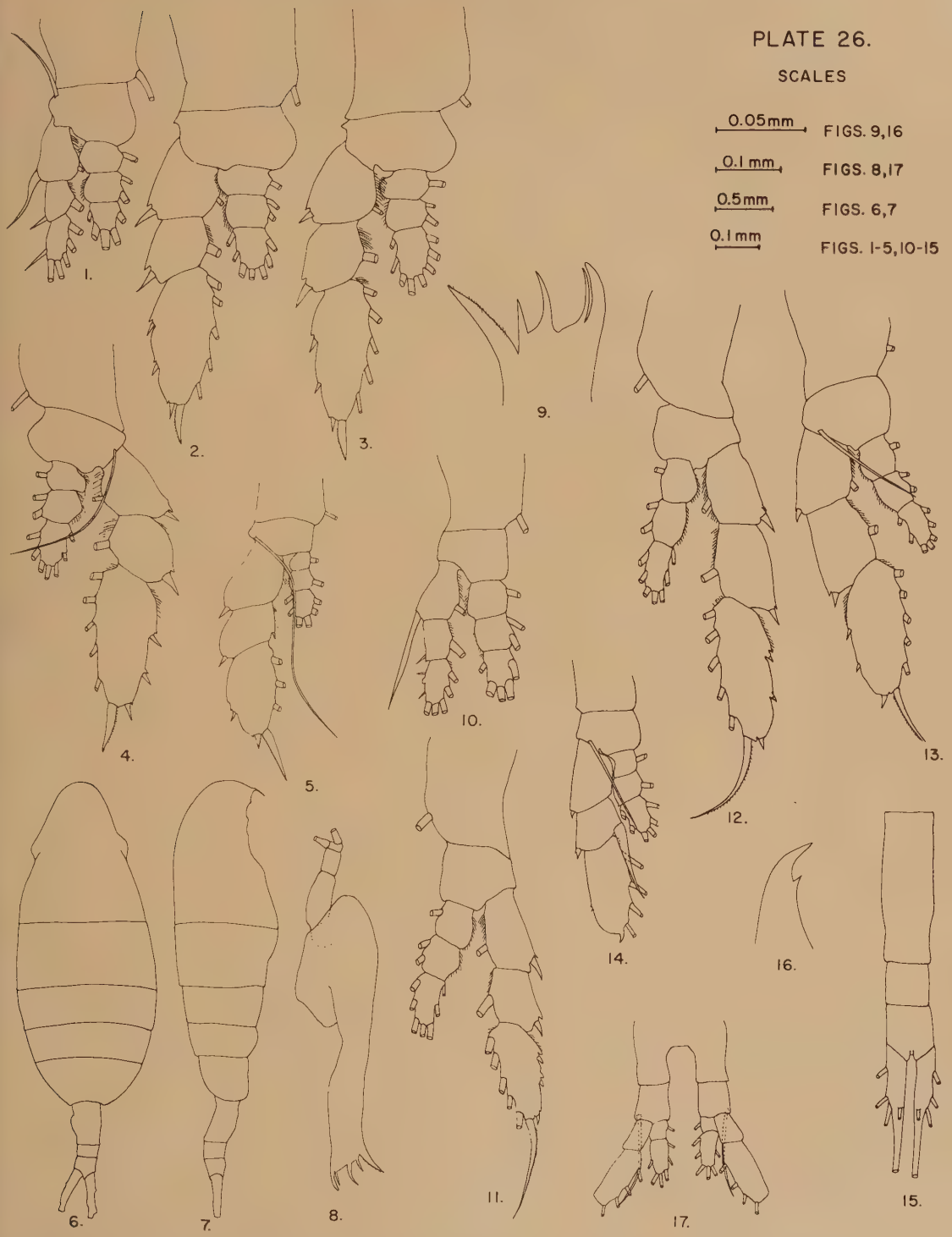


PLATE 26.—(1) *Haloptilus spiniceps*, female, first foot; (2) second foot; (3) third foot; (4) fourth foot; (5) fifth foot; (6) *Augaptilus longicaudatus*, female, dorsal view; (7) lateral view; (8) mandible; (9) gnathal lobe of mandible; (10) first foot; (11) second foot; (12) third foot; (13) fourth foot; (14) fifth foot; (15) *Euaugaptilus hecticus*, female, abdomen; (16) gnathal lobe of mandible; (17) fifth pair of feet.

*Augaptilus longicaudatus* (Claus, 1863)

(PLATE 26, FIGS. 6–14)

Pacific records: Esterly, 1905; Scott, 1909; Farran, 1929; 1936; Wilson, 1942; Brodsky, 1950; Wilson, 1950; Tanaka, 1953.

| Vessel: | Station | Occurrence |
|---|---|---|
| *Hugh M. Smith* | 94 | 1 female, 3.60 mm. |

Remarks: The asymmetrical genital segment (fig. 6), mandibular dentition (fig. 8), and structure of the fifth feet (fig. 14) will identify the female. No males were observed in the present collections.

*Euaugaptilus hecticus* (Giesbrecht, 1889)

(PLATE 26, FIGS. 15–17)

Pacific records: Farran, 1929; Wilson, 1950; Tanal 1953. As *Augaptilus hecticus;* Scott, 1909.

| Vessel: | Station | Occurrence |
|---|---|---|
| *Hugh M. Smith* | 31 | 2 females, 2.70 mm |
| *Stranger* | 34 | 1 female, 2.28 mm. |
| *Satsuma* | 32 | 1 female, 2.38 mm. |

Remarks: The very long genital segme (fig. 15), claw-like mandibular blade (fig. 1 and the 2-segmented exopods of the fifth fe (fig. 17) serve to identify this species.

Family ARIETELLIDAE

*Arietellus setosus* Giesbrecht, 1892

(PLATE 27, FIGS. 1–4)

Pacific records: Esterly, 1905; Scott, 1909; Esterly, 1911; Farran, 1929; Johnson, 1942; Wilson, 1942; Brodsky, 1950; Wilson, 1950.

| Vessel: | Station | Occurrence |
|---|---|---|
| *Hugh M. Smith* | 63 | 1 male, 3.99 mm. |

Remarks: The posterior thoracic margins are widely divergent (figs. 1, 3) and the forehead terminates in an acute point (fig. 2). Only the male has been found in the present samples.

*Arietellus giesbrechti* Sars, 1905

(PLATE 27, FIG. 5)

Pacific records: Wilson, 1950; Tanaka, 1953.

| Vessel: | Station | Occurrence |
|---|---|---|
| *Hugh M. Smith* | 29 | 1 male, 4.75 mm. |

Remarks: In the male the left posterior thoracic margin is slightly longer than the right. The fifth feet, shown here (fig. 5), are also diagnostic. No females were observed.

*Arietellus plumifer* Sars, 1905

(PLATE 27, FIGS. 6–10)

Pacific records: Wilson, 1950.

| Vessel: | Station | Occurrence |
|---|---|---|
| *Hugh M. Smith* | 94 | 1 juvenile female. |
| Do | 63 | 1 female, 5.51 mm. |

Remarks: The posterior margins of t thorax are symmetrical and turned upwa (figs. 6, 7, 9), and the head has a small poi (figs. 7, 8). No males were found.

*Arietellus aculeatus* (T. Scott, 1894)

(PLATE 27, FIGS. 11–14)

Pacific records: Scott, 1909; Farran, 1929; Wils 1950.

| Vessel: | Station | Occurrence |
|---|---|---|
| *Hugh M. Smith* | 63 | 1 juvenile female, 4.08 mm. |

Remarks: The forehead is produced into long point (fig. 11). The posterior thorac margins are asymmetrical and the spinous pr trusion of the right side is more divergent a longer than the one on the left (figs. 11, 13).

Farran (1929) has suggested that *A. arm tus* Wolfenden, 1911 is probably a synonym *A. aculeatus*. Wilson (1950), however, reco nized *armatus* as a valid species and redescrib both sexes.

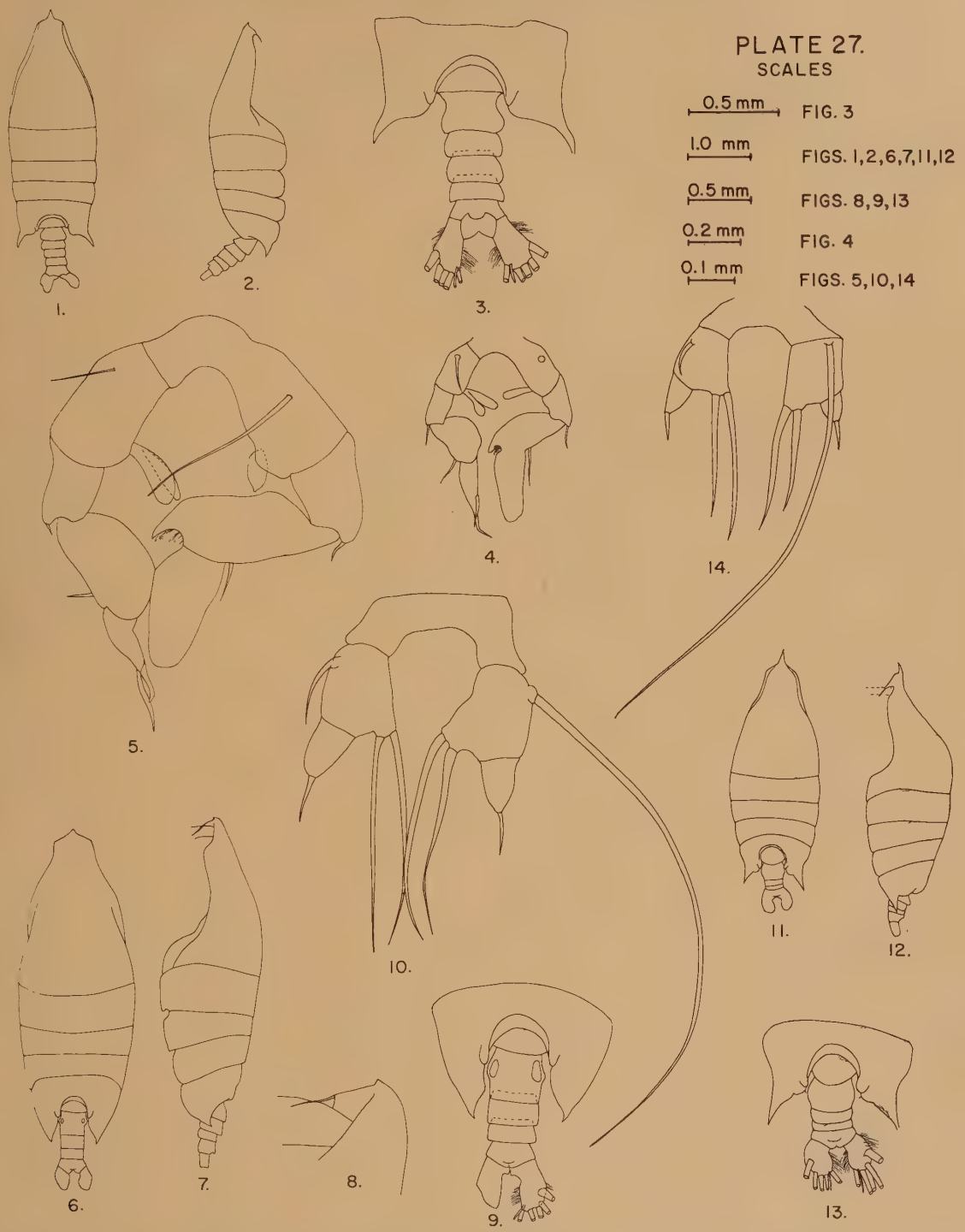


PLATE 27.—(1) *Arietellus setosus*, male, dorsal view; (2) lateral view; (3) posterior part of thorax and abdomen, dorsal view; (4) fifth pair of feet; (5) *A. giesbrechti*, male, fifth pair of feet; (6) *A. plumifer*, female, dorsal view; (7) lateral view; (8) forehead, lateral view; (9) posterior part of thorax and abdomen, dorsal view; (10) fifth pair of feet; (11) *A. aculeatus*, juvenile female, dorsal view; (12) lateral view; (13) posterior part of thorax and abdomen, dorsal view; (14) fifth pair of feet.

Family CANDACIIDAE

*Candacia longimana* (Claus, 1863)

(PLATE 28, FIGS. 1–12)

Pacific records: Scott, 1909; Farran, 1929; 1936; Mori, 1937; 1942; Wilson, 1942; 1950; Honjo, 1952; Tanaka, 1953; Anraku, 1954b; Tsuruta and Chiba, 1954b; Chiba, Tsuruta, and Maéda, 1955; Nagaya et al., 1955; Chiba, 1956; Heinrich, 1957b; Honjo et al., 1957; Yamazi, 1958a.

| Vessel: | Station | Occurrence |
|---|---|---|
| *Horizon* | 32 | 2 females, 2.82, 2.92 mm.; 1 male, 2.69 mm. |
| *Satsuma* | 32 | 1 female, 2.89 mm. |

Remarks: Twelve species of *Candacia* were found in the collections. For each species, excepting *C. guggenheimi* which has recently been described (Grice and Jones, 1960), I have usually included figures of the dorsal and lateral views of both sexes. Figures are also given of the fifth feet of each species and, for most species, figures of certain of the cephalic appendages (gnathal lobe of the mandible, second maxilla and maxilliped) are given. The females of the species herein described are easily recognized by the forms of the genital segment and fifth feet. The males are recognized by the character of the spine-like protrusion of the right posterior thoracic margin, the structure of the abdomen and the form of the fifth feet.

The female of *C. longimana* has a symmetrical genital segment (fig. 1), the basal tooth of the mandible is tricuspate (fig. 3), and the fifth foot terminates in 3 sub-equal points (figs. 4, 5). The right posterior thoracic margin of the male ends in an irregular protrusion (figs. 6, 7) which in lateral view is seen to turn upward (fig. 9). The right side of the genital segment has a large finger-like protrusion. The right fifth foot is chelate (fig. 11) and the distal margin of the last segment of the left foot ends in 3 small points (fig. 12).

*Candacia guggenheimi* Grice and Jones, 1960

Pacific records: Grice and Jones, 1960.

| Vessel: | Station | Occurrence |
|---|---|---|
| *Hugh M. Smith* | 29 | present. |

Remarks: This species has recently been described elsewhere (Grice and Jones, 1960). The genital segment of the female has two small spines on the dorsal surface and the genital segment of the male has a bilobed protrusion extending from the right side.

*Candacia tenuimana* (Giesbrecht, 1889)

(PLATE 28, FIGS. 13–18; PLATE 29, FIGS. 1–4)

Pacific records: Scott, 1909; Johnson, 1942; Wilson, 1942; 1950.

| Vessel: | Station | Occurrence |
|---|---|---|
| *Hugh M. Smith* | 29 | 1 female, 2.07 mm.; 1 male, 2.20 mm. |

Remarks: The female genital segment is slightly asymmetrical, the right side being more produced than the left (fig. 13, 15). The basal tooth of the mandible has 2 unequal cusps (fig. 17). The innermost spine-like protrusion of the distal segment of the fifth foot (fig. 18) is considerably longer than the other two. The spine-like protrusion on the right posterior thoracic margin of the male has a bifid tip (fig. 1, 2) and the genital segment is produced to the right in the form of a narrow, curved, spine-like process (fig. 2). As in the preceding species, the right fifth foot is chelate (fig. 4).

*Candacia aethiopica* (Dana, 1849)

(PLATE 29, FIGS. 5–16)

Pacific records: Streets, 1877; Esterly, 1905; Scott, 1909; Farran, 1929; Yamada, 1933a; Tanaka, 1935b; Farran, 1936; Mori, 1937; Dakin and Colefax, 1940; Johnson, 1942; Mori, 1942; Wilson, 1942; 1950; Tanaka, 1953; Anraku, 1954b; Tsuruta and Chiba, 1954b; Chiba, Tsuruta, and Maéda, 1955; Nagaya et al., 1955; Chiba, 1956; Honjo et al., 1957; Gilmartin, 1958.

| Vessel: | Station | Occurrence |
|---|---|---|
| *Hugh M. Smith* | 30 | 1 male, 2.24 mm. |
| *Horizon* | 32 | 1 female, 2.21 mm.; 3 males 2.18–2.24 mm. |
| *Satsuma* | 32 | 1 female, 1.97 mm. |

Remarks: Of the two spine-like protrusions on the female genital segment, the one on the left is the larger (figs. 5, 7). The basal tooth of the mandible has 3 cusps, the middle one of which is the larger (fig. 9). The distal segment of the fifth foot has 1 external spine, 3

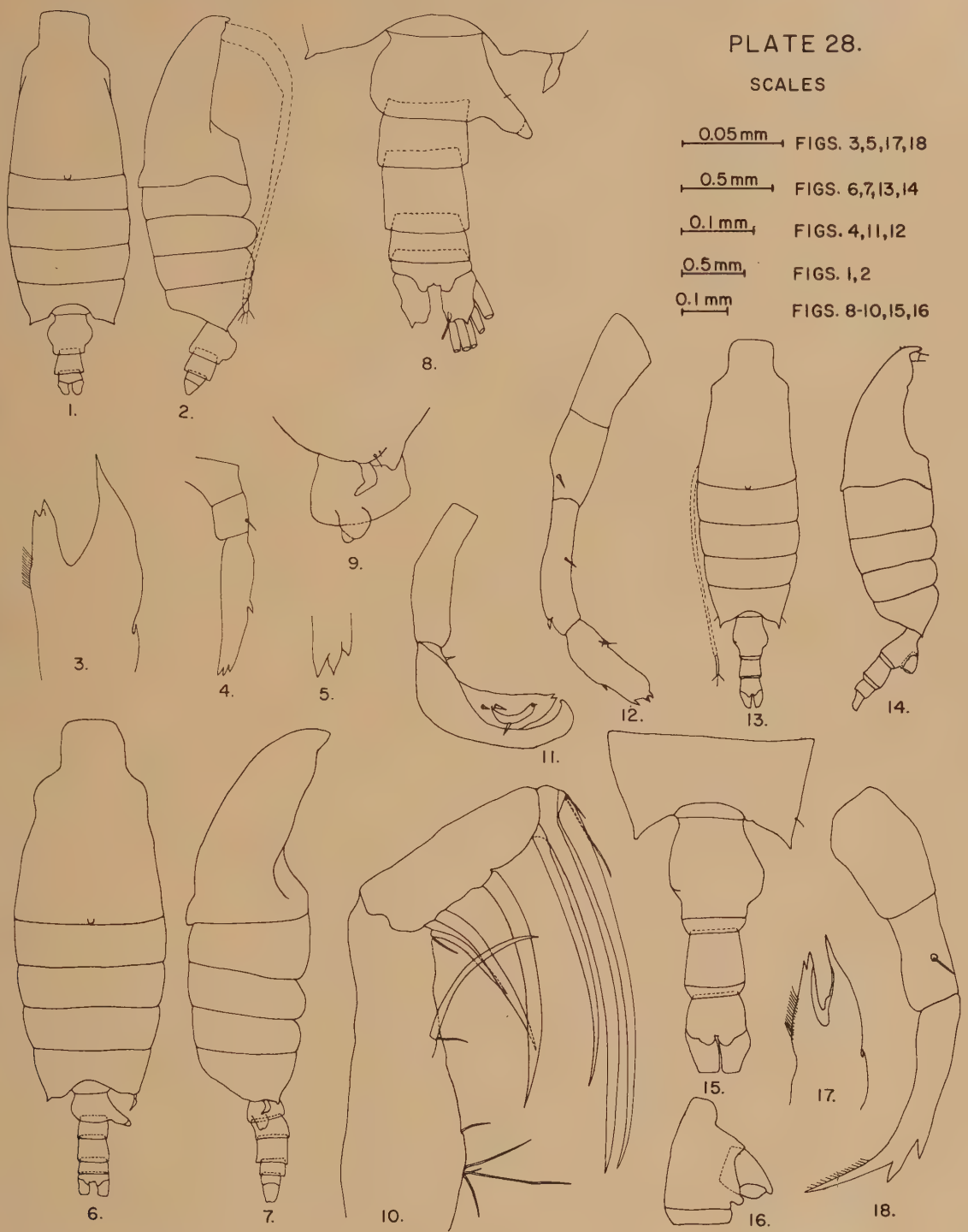


PLATE 28.—(1) *Candacia longimana*, female, dorsal view; (2) lateral view; (3) gnathal lobe of mandible; (4) fifth foot; (5) tip of fifth foot; (6) male, dorsal view; (7) lateral view; (8) abdomen, dorsal view; (9) posterior lateral corner of thorax and genital segment, right side; (10) second maxilla; (11) right fifth foot; (12) left fifth foot; (13) *C. tenuimana*, female, dorsal view; (14) lateral view; (15) posterior part of thorax and abdomen, dorsal view; (16) genital segment, lateral view; (17) gnathal lobe of mandible; (18) fifth foot.

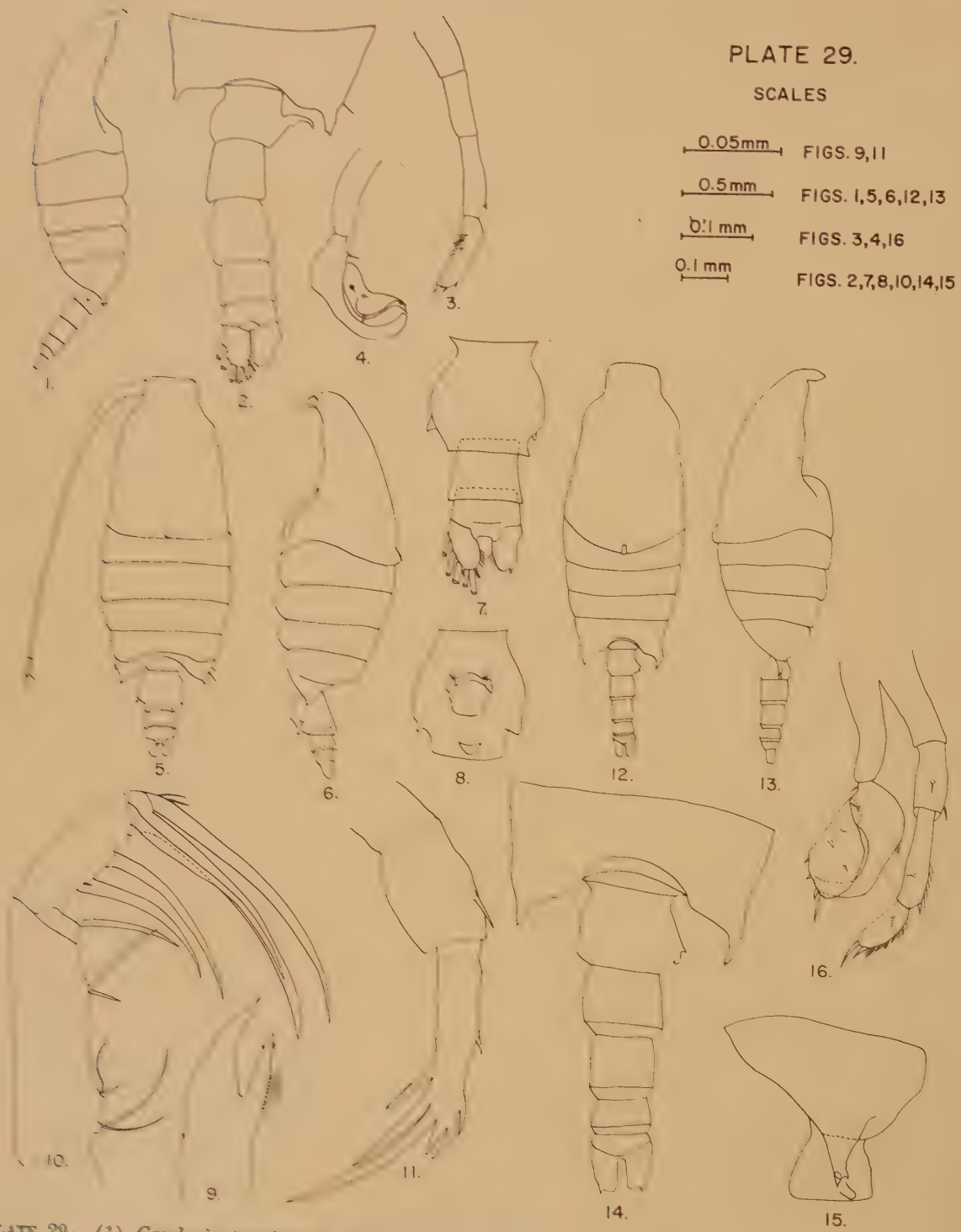


PLATE 29.—(1) *Candacia tenuimana*, male, lateral view; (2) posterior part of thorax and abdomen, dorsal view; (3) left fifth foot; (4) right fifth foot; (5) *C. aethiopica*, female, dorsal view; (6) lateral view; (7) abdomen, dorsal view; (8) genital segment, ventral view; (9) gnathal lobe of mandible; (10) second maxilla; (11) fifth foot; (12) male, dorsal view; (13) lateral view; (14) posterior part of thorax and abdomen, dorsal view; (15) posterior lateral corner of thorax and genital segment, right side; (16) fifth pair of feet.

erminal points and 3 internal, apparently unrticulated, setae (fig. 11). The male has a ifid spine-like protrusion (lateral view) exending from the right posterior margin of the horax (figs. 13, 15). There is a rounded tuercle and a spine-like point arising from the ight side of the genital segment (fig. 14). The hela of the right fifth foot is broad and spinus (fig. 16).

*Candacia pachydactyla* (Dana, 1849)

(PLATE 30, FIGS. 1–9)

Pacific records: Scott, 1909; Tanaka, 1935; Mori, 937; Dakin and Colefax, 1940; Wilson, 1942; 1950; hiba, 1952c; Tanaka, 1953; Tsuruta and Chiba, 1954b; hiba, Tsuruta, and Maéda, 1955; Hida and King, 955; Nagaya et al., 1955; Chiba, 1956; Honjo et al., 957; Yamazi, 1958a.

| essel: | Station | Occurrence |
|---|---|---|
| *Hugh M. Smith* | 132 | 2 males, 2.52 mm. |
| Do | 153 | 1 female, 2.82 mm.; 1 male, 2.07 mm. |
| Do | 178 | 2 males, 2.52 mm. |
| Do | 30 | 4 females, 2.48–2.55 mm.; 1 male, 2.48 mm. |
| Do | 63 | 1 female, 2.88 mm.; 4 males, 2.45–2.72 mm. |
| *Stranger* | 34 | 3 females, 2.62–2.65 mm.; 2 males, 2.38, 2.52 mm. |
| *Orsom* | 10 | 1 male, 2.48 mm. |
| *Horizon* | 32 | 6 females, 2.55–2.62 mm.; 6 males, 2.31–2.55 mm. |

Remarks: This is a robust species and is asily distinguished by the coarse spine-like rotrusions of the genital segment of the fenale (figs. 1, 2). The basal tooth of the manible ends in 3 very unequal cusps (fig. 3). The listal segment of the fifth feet ends in 3 points, he innermost one of which is curved (fig. 4). The right posterior margin of the thorax of the nale (figs. 5, 6) is similar to that of *C. aethiopica* but the protrusion of the genital segment s quite large (fig. 7). The thumb of the chela on the right fifth foot ends in a long spine as does the distal segment of the left foot (figs. 8, 9).

*Candacia curta* (Dana, 1849)

(PLATE 30, FIGS. 10–14; PLATE 31, FIGS. 1–3)

Pacific records: Esterly, 1905; Scott, 1909; Farran, 1935b; Farran, 1936; Mori, 1937; Johnson, 1942; Wilson, 1942; 1950; Tanaka, 1953; Tsuruta and Chiba, 1954b; Chiba, Tsuruta, and Maéda, 1955; Nagaya et al., 1955; Chiba, 1956; Honjo et al. 1957; Yamazi, 1958a. As *C. bicornuta;* Mori, 1932.

| Vessel: | Station | Occurrence |
|---|---|---|
| *Hugh M. Smith* | 29 | 2 females, 2.48. 2.62 mm.; 2 males, 2.28, 2.34 mm. |
| *Orsom* | 10 | 1 female, 2.44 mm.; 1 male, 2.20 mm. |
| *Horizon* | 32 | 1 female, 2.58 mm. |

Remarks: The female genital segment is slightly asymmetrical in dorsal view (fig. 10) and has a spine-like protrusion on the ventral side (fig. 11). This spine-like protrusion originates from the right side of the segment (fig. 12). The basal tooth of the mandible has 3 cusps, the lowermost one of which arises from behind the other two (fig. 13). There are 2 points on the distal end of the fifth foot and another point a short distance back of the distal end (fig. 14). The right posterior thoracic margin of the male ends in a hooked spine-like point (fig. 1) and there is a curved, pointed protrusion from the right side of the genital segment (fig. 2). The chela of the fifth foot is also diagnostic (fig. 3).

*Candacia bipinnata* (Giesbrecht, 1889)

(PLATE 31, FIGS. 4–7)

Synonymy:

*Candacia bipinnata* (Giesbrecht, 1889, Atti Acc. Lincei Rend., ser. 4, 5 sem. 1: 815).

*Candacia pectinata* (not of Brady, 1878) Esterly (1905, Univ. Calif. Publ. Zool., 2(4): 193); Mori (1937, The pelagic Copepoda from the neighboring waters of Japan, p. 83); Dakin and Colefax (1940, Publ. Univ. Sydney Dept. Zool. Monogr. 1, p. 105). (*C. pectinata* Brady, 1878=*C. armata* Boeck, 1873.)

Pacific records: Esterly, 1905; Scott, 1909; Tanaka, 1929; Yamada, 1933; Tanaka, 1935b; Mori, 1937; Dakin and Colefax, 1940; Johnson, 1942; Wilson, 1942; Davis, 1949; Motoda, Iizuka, and Anraku, 1950; Brodsky, 1950; Wilson, 1950; Anraku, 1952; Honjo, 1952; Anraku, 1953; Tanaka, 1953; Anraku, 1954b; Chiba, Tsuruta, and Maéda, 1955; Motoda and Anraku, 1955; Nagaya et al., 1955; Chiba, 1956; Honjo et al., 1957;

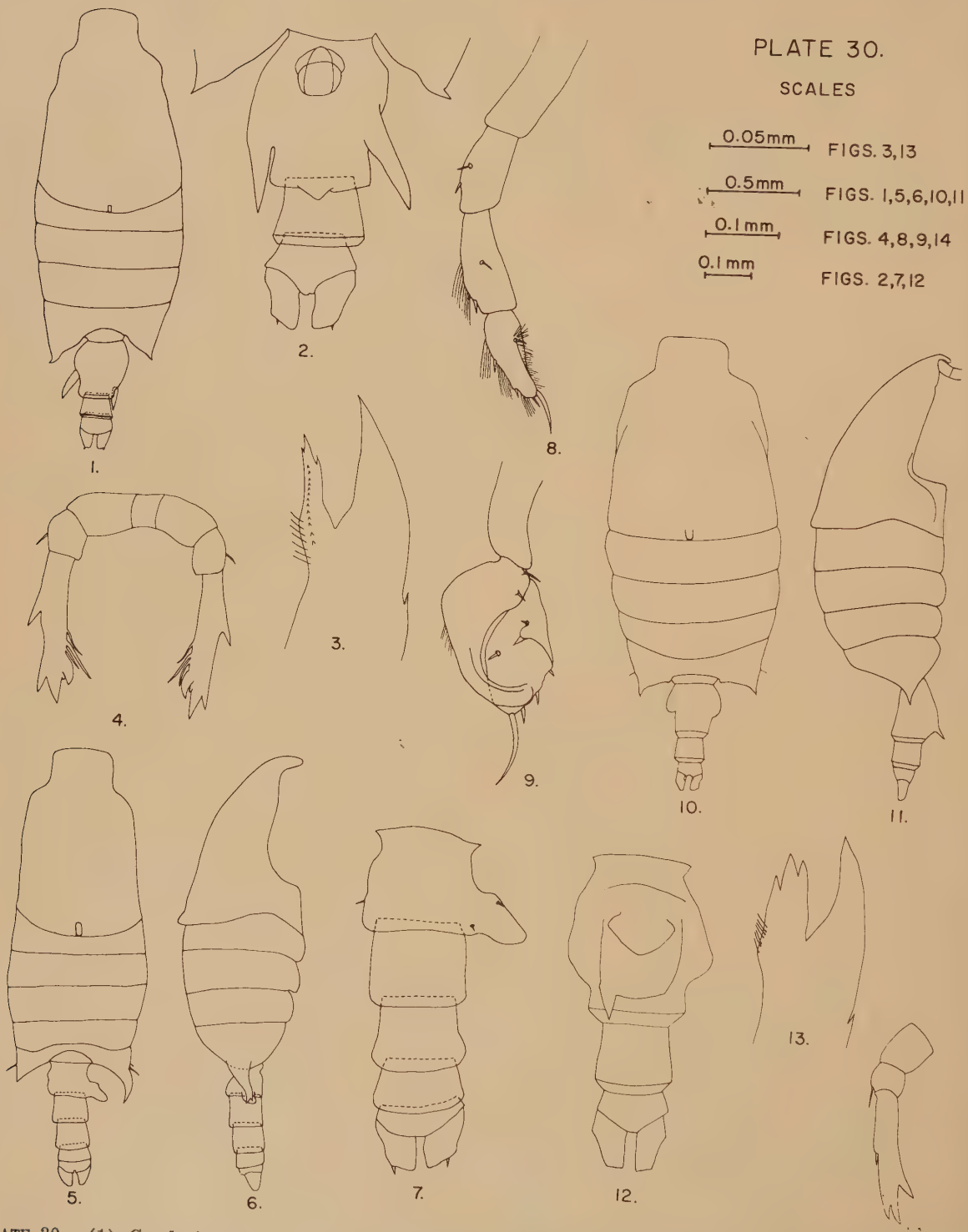


PLATE 30.—(1) *Candacia pachydactyla*, female, dorsal view; (2) abdomen, ventral view; (3) gnathal lobe of mandible; (4) fifth pair of feet; (5) male, dorsal view; (6) lateral view; (7) abdomen, dorsal view; (8) left fifth foot; (9) right fifth foot; (10) *C. curta*, female, dorsal view; (11) lateral view; (12) abdomen, ventral view; (13) gnathal lobe of mandible; (14) fifth foot.

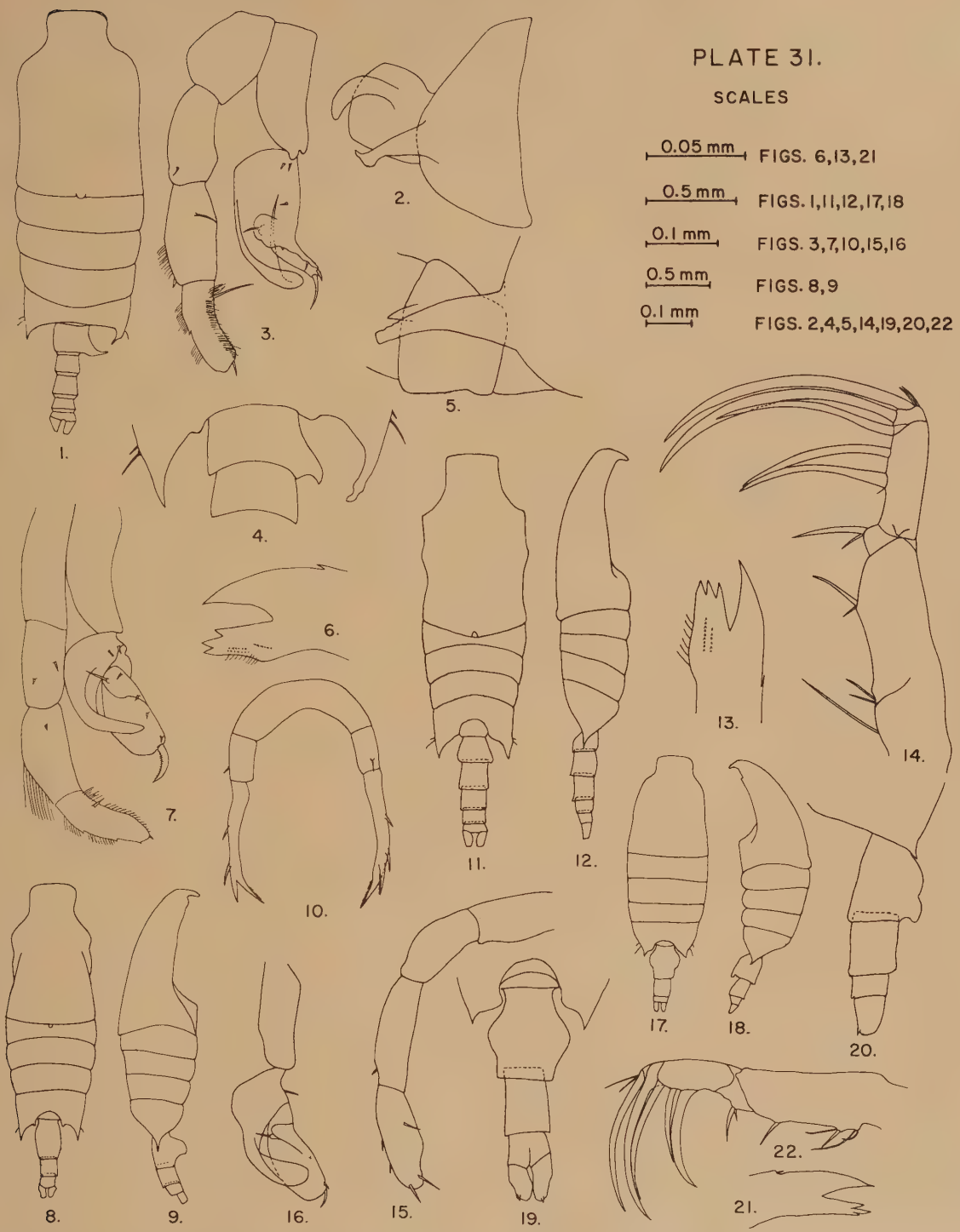


PLATE 31.—(1) *Candacia curta*, male, dorsal view; (2) posterior part of thorax and genital segment, right side; (3) fifth pair of feet; (4) *C. bipinnata*, male, posterior part of thorax and abdomen, dorsal view; (5) posterior part of thorax and abdomen, right side; (6) gnathal lobe of mandible; (7) fifth pair of feet; (8) *C. varicans*, female, dorsal view; (9) lateral view; (10) fifth pair of feet; (11) male, dorsal view; (12) lateral view; (13) gnathal lobe of mandible; (14) second maxilla; (15) left foot; (16) right foot; (17) *C. catula*, female, dorsal view; (18) lateral view; (19) abdomen, dorsal view; (20) abdomen, lateral view; (21) gnathal lobe of mandible; (22) second maxilla.

Yamazi, 1958a; Brodsky, 1959; Lindberg, 1959. As *C. bipunctata* [=*C. bipinnata*?]; Yamazi, 1953a.

| Vessel: | Station | Occurrence |
|---|---|---|
| *Hugh M. Smith* | 178 | 1 male, 1.90 mm. |
| Do | 144 | 1 male, 2.28 mm. |

Remarks: Only two males of this species were found. The right posterior lateral protrusion of the thorax is characteristic. This protrusion exceeds the end of the genital segment and its tip, as seen in dorsal view, is irregular (fig. 4). In lateral view the distal end appears to be somewhat truncate (fig. 5). A small, posteriorly directed hook arises from the right side of the genital segment (fig. 4). The basal tooth of the gnathal lobe of the mandible is tricuspate (fig. 6). The thumb of the chela of the right fifth foot has a stout spine at its tip.

In regard to the above indicated synonymy, Sars (1903) redescribed *C. armata* (Boeck, 1873) and pointed out that *C. pectinata* (Brady, 1878) is a synonym of the former species. *C. armata* is a north Atlantic species which occurs along the east coast of the United States as far south as off Beaufort, North Carolina (Fleminger and Bowman, 1956), and along the coast of Europe probably as far south as off Spain. It has also been reported from the Mediterranean Sea (Rose, 1934) and from the Adriatic Sea (Hure, 1955).

I have examined specimens identified by Esterly (1905) and labeled *C. bipinnata* ♀, *C. pectinata* ♂, which were loaned to me by Dr. Abraham Fleminger of the Scripps Institution of Oceanography. Included in the vial were two females, *C. bipinnata*. Esterly's figure of the fifth foot of his female *C. pectinata* is probably that of a stage V female *C. bipinnata*, a species which also occurred in his collections. The figure of the genital segment of his male *C. pectinata* is clearly referable to *C. bipinnata*. Esterly stated in regard to *C. bipinnata* that he did not find the male of this species.

Mori (1937) reported only the male of *C. pectinata* from Japanese waters. His figures and description of this species indicate that it is actually *C. bipinnata*. The protrusion of the right posterior lateral margin of the thorax, the form of the hook on the right side of the genital segment, and the structure of the fifth pair of feet all agree with those of *C. bipinnata*. Mori also presented figures of male *C. bipinnata* which are not unlike those of his *C. pectinata*.

Dakin and Colefax's (1940) *C. pectinata* (both sexes) which were questionably referred to this species are also *C. bipinnata*. I have examined specimens which were obtained from the east coast of Australia and which are similar to the figures presented by these authors for *C. pectinata*. These copepods are stage V female and adult male *C. bipinnata*.

As to other reports of *C. pectinata* from the Pacific Ocean, Scott (1909) has previously stated that Brady's (1883) figures of this species "represents at least four distinct species none of which are identical with it" (*C. pectinata*=*C. armata*). *C. pectinata* has also been reported by Honjo (1952) and Honjo et al. (1957). As the species is included in lists without descriptions or figures, these records too are questionable and in need of confirmation.

### *Candacia varicans* (Giesbrecht, 1892)

(PLATE 31, FIGS. 8–16)

Pacific records: Farran, 1929; Johnson, 1942; Wilson, 1942; 1950.

| Vessel: | Station | Occurrence |
|---|---|---|
| *Hugh M. Smith* | 31 | 2 males, 2.14, 2.18 mm. |
| Do | 63 | 1 female, 2.55 mm.; 2 males, 2.26, 2.28 mm. |

Remarks: The female has a long and symmetrical genital segment (fig. 8) which is produced on the ventral side (fig. 9). The fifth feet are slightly asymmetrical and terminate in two rather long, but unequal, points (fig. 10). The thorax and genital segment of the male are symmetrical (figs. 11, 12). The basal tooth of the mandible ends in three approximately equal cusps. The right fifth foot is chelate (fig. 16).

### *Candacia catula* (Giesbrecht, 1889)

(PLATE 31, FIGS. 17–22; PLATE 32, FIGS. 1–6)

Pacific records: Scott, 1909; Tanaka, 1935b; Farran, 1936; Mori, 1937; Dakin and Colefax, 1940; Mori, 1942; Wilson, 1942; Anraku, 1952; Tanaka, 1953;

suruta and Chiba, 1954b; Chiba, Tsuruta, and Maéda, 55; Nagaya et al., 1955; Yamazi, 1958a.

| essel: | Station | Occurrence |
|---|---|---|
| *Hugh M. Smith* | 178 | present. |
| Do | 63 | 2 females, 1.56, 1.63 mm.; 2 males, 1.46, 1.53 mm. |
| *Stranger* | 34 | 7 females, 1.60–1.67 mm.; 2 males, 1.53, 1.62 mm. |
| *Orsom* | 10 | 1 female, 1.53 mm.; 1 male, 1.43 mm. |
| *Horizon* | 32 | 1 female, 1.59 mm. |

Remarks: This is a small species, the females f which have a symmetrical genital segment figs. 17, 19). The ventral surface is produced nto a lobe (figs. 18, 20). The basal tooth of he mandible ends in 3 cusps, the lowermost ne of which is quite small (fig. 21). The fifth ot terminates in 3 unequal points (fig. 1). he male posterior thoracic margins are symetrical (figs. 2, 4) and the chela of the right fth foot is small. The thumb of the chela has long spine protruding from its tip (fig. 6).

*Candacia bispinosa* (Claus, 1863)

(PLATE 32, FIGS. 7–14)

Pacific records: Scott, 1909; Farran, 1929; Tanaka, 935b; Farran, 1936; Mori, 1937; Johnson, 1942; Wilon, 1942; 1950; Honjo, 1952; Tanaka, 1953; Anraku, 954b; Tsuruta and Chiba, 1954b; Chiba, Tsuruta, nd Maéda, 1955; Motoda and Anraku, 1955; Nagaya t al., 1955; Chiba, 1956; Heinrich, 1957b; Honjo et al., 957; Heinrich, 1958a; Yamazi, 1958a.

| essel: | Station | Occurrence |
|---|---|---|
| *Hugh M. Smith* | 153 | 3 females, 1.66–1.80 mm. |
| Do | 178 | 1 female, 1.60 mm. |
| *Stranger* | 34 | 1 female, 1.67 mm.; 1 male, 1.73 mm. |
| *Orsom* | 10 | 1 female, 1.56 mm.; 1 male, 1.56 mm. |
| *Satsuma* | 32 | 1 male, 1.70 mm. |

Remarks: This species and the following two pecies, *C. simplex* (Giesbrecht) and *C. truncata* (Dana), differ in a few details (e.g., structure of right, first antenna in male and fifth eet in both sexes) from the preceding nine pecies. It has been suggested by Sars (1903) hat these three may have to be removed from he genus *Candacia*.

The female of *C. bispinosa* has two spine-like protrusions arising from the genital segment (fig. 7). These protrusions, particularly the one on the left side, are quite variable in shape and in size. In one specimen (*Smith* 178) the left protrusion reaches nearly to the anal segment. There is a small rounded knob arising from the ventral side of the genital segment near the posterior end (fig. 8). The pre-anal segment is asymmetrical. The left side is dilated near the anterior end, but there is some variation in the size of the protrusion. The ventral surface of this segment may or may not have a row of hairs arising from near the posterior end. The basal tooth of the mandible is undivided, but one or more spine-like processes are present on this tooth (fig. 9). The large terminal finger-like protrusion of the distal segment of the fifth foot is finely serrate on both sides (fig. 12).

Segment 20 of the right first antenna of the male is swollen distally (fig. 13). There are 3 outer edge spines on the distal segment of the right fifth foot (fig. 14). The proximal spine is shorter than the distal two spines. The penultimate segment of the left fifth foot is enlarged and the outer edge seta of the distal segment is shorter than the terminal ones.

*Candacia simplex* (Giesbrecht, 1889)

(PLATE 32, FIGS. 15–18; PLATE 33, FIGS. 1–5)

Pacific records: Scott, 1909; Farran, 1929; 1936; Mori, 1937; Johnson, 1942; Mori, 1942; Wilson, 1942; 1950; Tanaka, 1953; Tsuruta and Chiba, 1954b; Chiba, Tsuruta, and Maéda, 1955; Nagaya et al., 1955; Rose, 1955; Chiba, 1956.

| Vessel: | Station | Occurrence |
|---|---|---|
| *Hugh M. Smith* | 94 | 1 female, 1.93 mm. |
| Do | 132 | 8 females, 1.73–1.87 mm.; 3 males 1.73–1.83 mm. |
| Do | 144 | present. |
| Do | 153 | 1 female, 1.67 mm. |
| Do | 178 | 2 females, 1.90 mm.; 1 male, 1.80 mm. |

Remarks: The genital segment of the female is slightly asymmetrical and has a group of small hair-like structures which are visible on the right side (figs. 15, 16). The terminal finger of the distal segment of the fifth foot is

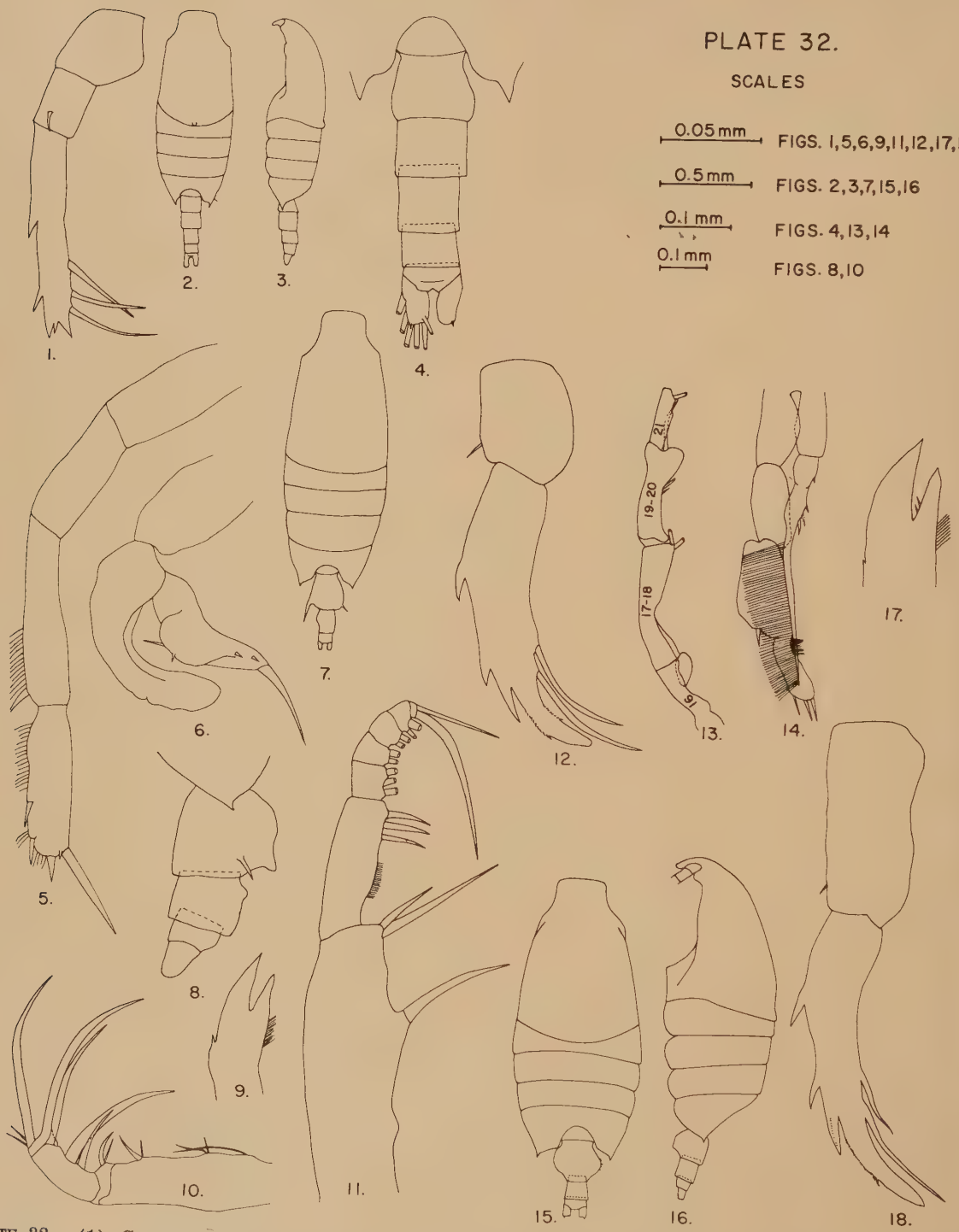


PLATE 32.—(1) *Candacia catula*, female, fifth foot; (2) male, dorsal view; (3) lateral view; (4) abdomen, dorsal view; (5) left fifth foot; (6) right fifth foot; (7) *C. bispinosa*, female, dorsal view; (8) abdomen, right side; (9) gnathal lobe of mandible; (10) second maxilla; (11) maxilliped; (12) fifth foot; (13) male, segments 16 to 21 of right first antenna; (14) fifth pair of feet; (15) *C. simplex*, female, dorsal view; (16) lateral view; (17) gnathal lobe of mandible; (18) fifth foot.

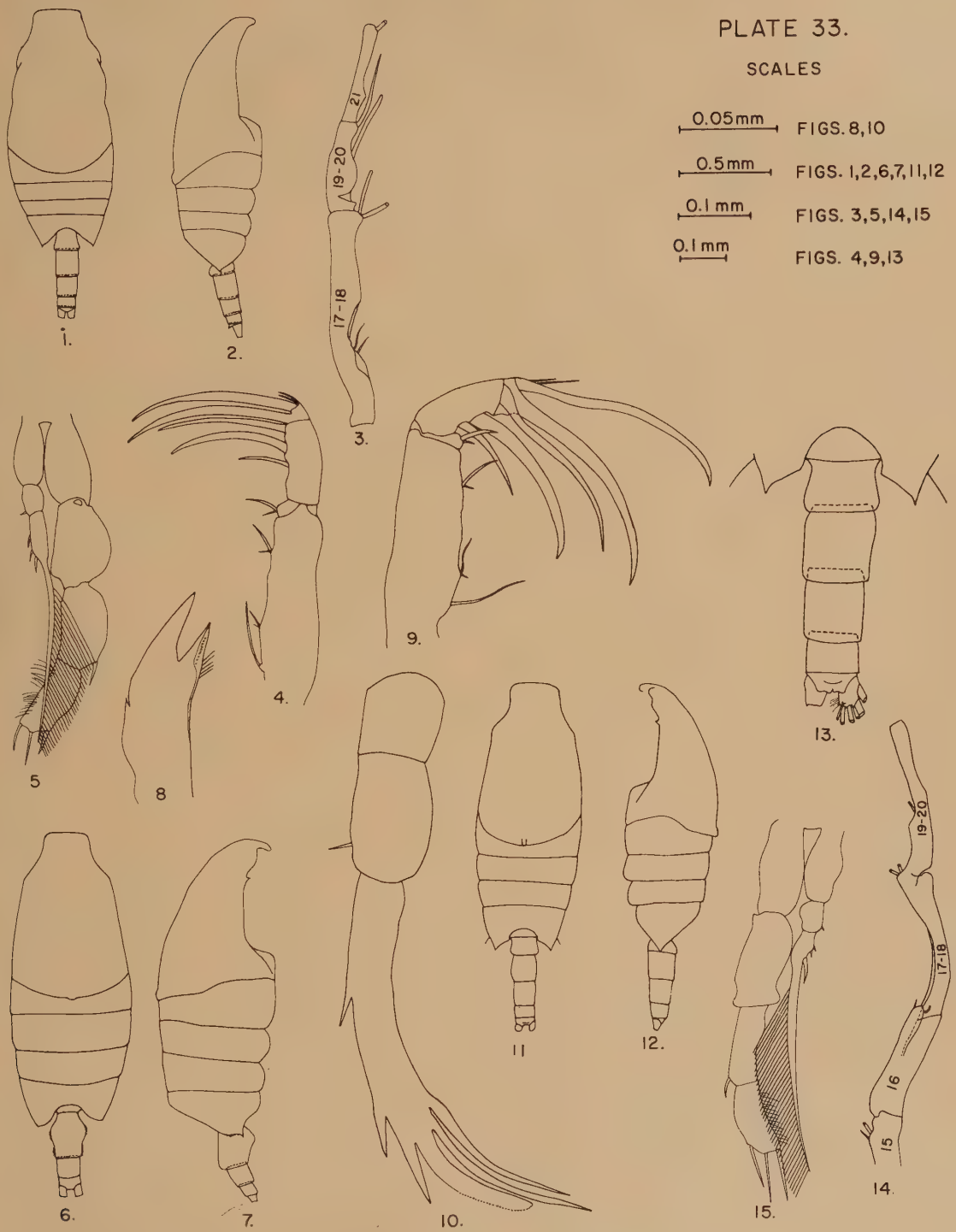


PLATE 33.—(1) *Candacia simplex*, male, dorsal view; (2) lateral view; (3) segments 17 to 21 of right first ntenna; (4) second maxilla; (5) fifth pair of feet; (6) *C. truncata*, female, dorsal view; (7) lateral view; 8) gnathal lobe of mandible; (9) second maxilla; (10) fifth foot; (11) male, dorsal view; (12) lateral view; 13) abdomen, dorsal view; (14) segments 15 to 20 of right first antenna; (15) fifth pair of feet.

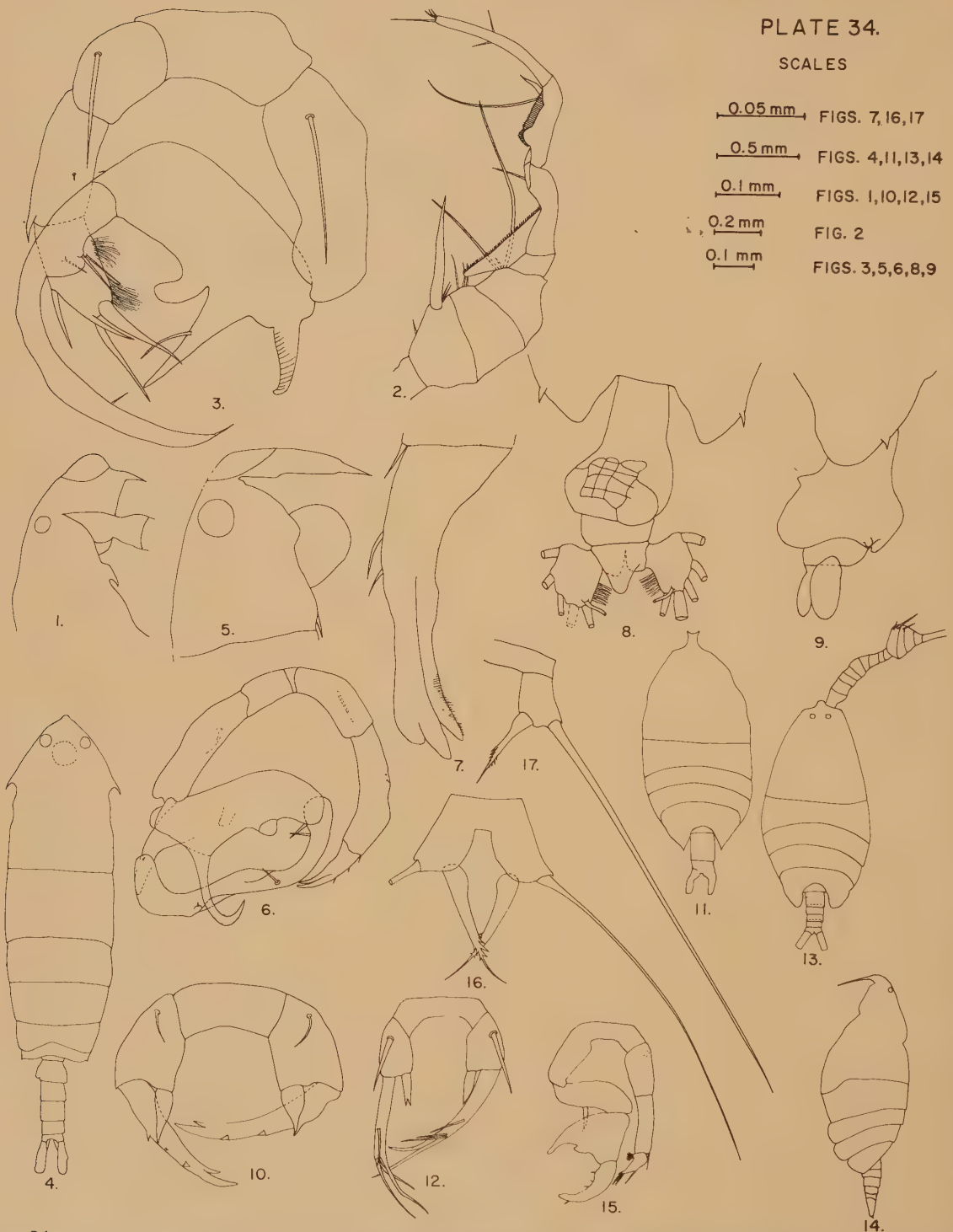


PLATE 34.—(1) *Pontella securifer*, male, forehead, lateral view; (2) distal end of right first antenna; (3) fifth pair of feet; (4) *P. tenuiremis*, male, dorsal view; (5) forehead, lateral view; (6) fifth pair of feet; (7) left fifth foot; (8) *Labidocera detruncata*, female, abdomen, dorsal view; (9) lateral view; (10) fifth pair of feet; (11) *Pontellina plumata*, female, dorsal view; (12) fifth pair of feet; (13) male, dorsal view; (14) lateral view; (15) fifth pair of feet; (16) *Acartia danae*, female, fifth foot; (17) *A. negligens*, female, fifth pair of feet.

nely serrate on the external margin (fig. 18). f the 2 internal setae on this segment, the istal one is approximately twice the length of ie proximal one. The male thorax and abomen are symmetrical (figs. 1, 2). The right fth foot is similar to that of *C. bispinosa* (fig. ). The left fifth foot terminates in 3 setae, ie middle one of which is the longer. The enultimate segment is not particularly enirged.

*Candacia truncata* (Dana, 1849)

(PLATE 33, FIGS. 6–14)

Pacific records: Scott, 1909; Yamada, 1933a; Taaka, 1935b; Farran, 1936; Mori, 1937; Dakin and olefax, 1940; Mori, 1942; Wilson, 1942; Tanaka, 1953; nraku, 1954b; Tsuruta and Chiba, 1954b; Chiba, Tsuta, and Maéda, 1955; Motoda and Anraku, 1955; agaya et al., 1955; Chiba, 1956; Heinrich, 1957b; onjo et al., 1957; Yamazi, 1958a; 1958b; Grice and ones, 1960. As *C. turgida;* Wilson, 1950.

| Vessel: | Station | Occurrence |
|---|---|---|
| *Hugh M. Smith* | 132 | 3 females, 1.90–2.00 mm.; 2 males, 2.11 mm. |
| Do | 153 | 3 males, 1.97–2.11 mm. |
| Do | 30 | present. |
| Do | 63 | 1 female, 1.87 mm. |
| *Stranger* | 34 | 7 females, 1.94–2.04 mm.; 3 males, 1.94–1.97 mm. |
| *Orsom* | 10 | 3 females, 1.97–2.04 mm.; 1 male, 2.06 mm. |
| *Horizon* | 32 | 11 females, 1.84–2.00 mm.; 5 males, 1.94–2.00 mm. |
| *Satsuma* | 32 | 5 females, 1.87–1.90 mm.; 3 males, 1.87–2.00 mm. |

Remarks: The female genital segment is symmetrical and finely pubescent on the lateral margins (fig. 16). The terminal finger of the distal segment of the fifth foot is finely serrate along its outer distal margin (fig. 10). The proximal seta on the internal margin is slightly shorter than the distal one. The male thorax and abdomen are symmetrical (figs. 11, 12). Segment 16 of the right first antenna is produced into an elongate process (fig. 14). The distal spine on the terminal segment of the right fifth foot (fig. 15) is considerably larger than the preceding two spines. The terminal seta on some specimens is articulated to this segment while in others it is not.

Family PONTELLIDAE

*Pontella securifer* Brady, 1883

(PLATE 34, FIGS. 1–3)

Pacific records: Scott, 1909; Farran, 1936; Dakin nd Colefax, 1940; Wilson, 1942; 1950; Tanaka, 1953.

| Vessel: | Station | Occurrence |
|---|---|---|
| *Hugh M. Smith* | 30 | 2 females, 4.40, 4.46 mm. |
| Do | 31 | 1 male, 4.40 mm. |

Remarks: Both sexes have a large lens sitated at the base of the rostrum. Figures of ie male sex are given (figs. 1–3).

*Pontella tenuiremis* Giesbrecht, 1889

(PLATE 34, FIGS. 4–7)

Pacific records: Wilson, 1942; 1950.

| Vessel: | Station | Occurrence |
|---|---|---|
| *Horizon* | 32 | 1 male, 2.80 mm. |

Remarks: The structure of the fifth feet (figs. 6, 7) distinguishes the male of this species from other *Pontella.* No females were found.

*Labidocera detruncata* (Dana, 1849)

(PLATE 34, FIGS. 8–10)

Pacific records: Scott, 1909; Yamada, 1933; Farran, 1936; Mori, 1937; Dakin and Colefax, 1940; Mori, 1942; 1950; Tanaka, 1953; Anraku, 1954b; Chiba, Tsuruta, and Maéda, 1955; Nagaya et al., 1955; Chiba, 1956; Yamazi, 1958a; 1958b.

| Vessel: | Station | Occurrence |
|---|---|---|
| *Hugh M. Smith* | 30 | 1 female, 2.72 mm. |
| Do | 32 | 1 female, 2.68 mm. |

Remarks: The lateral margins of the last thoracic segment (figs. 8, 9) are pointed and the genital segment is asymmetrical. These

two characters plus the structure of the fifth feet (fig. 10) will identify the female. No male was found in the present collections.

*Pontellina plumata* (Dana, 1849)

(PLATE 34, FIGS. 11–15)

Pacific records: Scott, 1909; Farran, 1929; 1936; Mori, 1937; Dakin and Colefax, 1940; Mori, 1942; Wilson, 1950; Anraku, 1952; Tanaka, 1953; Anraku, 1954b; Tsuruta and Chiba, 1954b; Chiba, Tsuruta, and Maéda, 1955; Motoda and Anraku, 1955; Nagaya et al., 1955; Chiba, 1956; Heinrich, 1958a; Yamazi, 1958a.

| Vessel: | Station | Occurrence |
|---|---|---|
| *Hugh M. Smith* | 132 | 1 female, 1.66 mm.; 2 males, 1.49, 1.59 mm. |
| Do | 178 | present. |
| Do | 30 | 9 females, 1.43–1.84 mm.; 1 male, 1.5 mm. |
| Do | 31 | 2 females, 1.62, 1.80 mm. |
| Do | 63 | present. |
| *Stranger* | 34 | 2 females, 1.56, 1.63 mm. |
| *Orsom* | 10 | present. |
| *Horizon* | 32 | present. |

Remarks: The female is distinguished b the symmetrically pointed posterior margins c the last thoracic segment (fig. 11) and th right furca. This furca is fused to the ana segment. The posterior lateral margins of th last thoracic segment of the male are rounde (figs. 13, 14) and the right fifth foot is chelat (fig. 15).

Family ACARTIIDAE

*Acartia danae* Giesbrecht, 1889

(PLATE 34, FIG. 16)

Pacific records: Scott, 1909; Farran, 1929; 1936; Mori, 1937; Dakin and Colefax, 1940; Johnson, 1942; Mori, 1942; Wilson, 1942; Davis, 1949; Wilson, 1950; Anraku, 1952; Tanaka, 1953; Anraku, 1954b; Motoda and Anraku, 1955; Heinrich, 1957b; Honjo et al., 1957; Heinrich, 1958a; Yamazi, 1958a; 1958b.

| Vessel: | Station | Occurrence |
|---|---|---|
| *Hugh M. Smith* | 94 | present. |
| Do | 132 | 1 female, 1.12 mm. |
| Do | 178 | present. |

Remarks: The female has a large spine on the first segment of the first antennae and the posterior lateral margins of the thorax end in a large point. The external seta on the fifth foot (fig. 16) is slightly more than twice the length of the internal spine.

*Acartia negligens* Dana, 1849

(PLATE 34, FIG. 17)

Pacific records: Scott, 1909; Farran, 1929; 1936; Mori, 1937; 1942; Wilson, 1942; 1950; Anraku, 1952; Honjo, 1952; Tanaka, 1953; Anraku, 1954b; Tsurut and Chiba, 1954b; Chiba, Tsuruta, and Maéda, 1955 Motoda and Anraku, 1955; Nagaya et al., 1955; Chib 1956; Heinrich, 1957b; 1958a; Yamazi, 1958a; 1958

| Vessel: | Station | Occurrence |
|---|---|---|
| *Hugh M. Smith* | 153 | 2 females, 1.05, 1.1 mm. |
| Do | 178 | present. |
| Do | 30 | 10 females, 1.08–1.21 mm. |
| Do | 31 | 5 females, 1.10–1.17 mm. |
| Do | 63 | present. |
| *Stranger* | 34 | 2 females, 1.08, 1.1 mm. |
| *Orsom* | 10 | 14 females, 1.10–1.16 mm. |
| *Satsuma* | 32 | present. |

Remarks: In contradistinction to *A. dana* the posterior lateral margins of the last thorac segment have a series of very small point The external seta on the fifth foot (fig. 17) more than four times the length of the intern spine.

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